CENTRALIZED PROCESSING of Fresh Meat for Retail Stores

An Interim Report

Marketing Research Report No. 628

UNITED STATES DEPARTMENT OF AGRICULTURE
Agricultural Marketing Service
Transportation & Facilities Research Division

PREFACE

This study of packaging retail cuts of fresh meat at central plants was conducted under the general direction of R. W. Hoecker, Chief, Wholesaling and Retailing Research Branch, Transportation and Facilities Research Division, Agricultural Marketing Service. It is part of a broad program of research aimed at reducing the costs of marketing farm products by increasing the efficiency of food wholesaling and retailing.

Twentieth Century Markets, Nashua, N.H.; Associated Grocers and Falley's, Topeka, Kans.; Cliff Brothers Supermarket, Dallas, Tex.; Victory Supermarkets, Norwich, N.Y.; and Cryovac, Simpsonville, S.C., provided the retail stores and other facilities used in this study. Photographs used in figures 21, 22, and 23 were supplied through courtesy of Supermarket Merchandising Magazine. Sykes E. Trieb, of Kansas State University, Manhattan, Kans., and Lowell Mohler, of the State Board of Agriculture, Topeka, Kans., assisted in setting up and operating central meat processing plants.

The study was conducted under the specific direction of Dale L. Anderson, Assistant Chief of the Wholesaling and Retailing Research Branch.

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SUMMARY

Processing retail cuts of fresh meat in a central plant for a group of retail stores can save thousands of dollars annually in construction, equipment, and labor costs--as much, for example, as $650,000 for a group of 40 stores with a yearly meat volume of $13,000,000. Benefits from such reductions in marketing costs are likely to be shared by consumers through lower prices at retail and by producers through higher prices for livestock.

These savings were projected from results obtained by research in smaller central plants. The savings represent approximately half of the operating costs, compared to those of a firm processing an equivalent volume of meat in conventional-store meat backrooms.

Central meat processing offers additional opportunities for savings due to: (1) Better distribution of meat cuts according to market preferences, (2) more uniform and efficient cutting methods, (3) better control of overhead costs, (4) advantages of quantity purchases, and (5) a better market for carcass byproducts.

Central processing of fresh meats has been attempted in this country by a number of firms, but, except in a few cases, has not been successful. The primary difficulties encountered by these concerns appeared to be over-ordering or under-ordering, due to poor production planning and control; and lack of shelf life, due to improper sanitation and temperature control. Because of the limited shelf life of fresh meat, quantities on display and production must be carefully controlled.

A system was developed by the researchers to provide industry with procedures for: (1) Determining how much and when to produce, (2) maintaining uniform workloads for men and equipment, (3) scheduling work to men and equipment, and (4) scheduling store deliveries.

Specially designed equipment and efficient work procedures can greatly increase productivity, thereby reducing the total operating costs by a substantial amount. Equipment and operational procedures recommended are:

1. The central plant should schedule the major part of the week's supply of meat products for delivery during the first part of the week, so that work schedules can be better balanced. The coolers should be designed with ample storage facilities to allow the central plant to receive on the basis of a limited number of shipments per week. This also permits shipment of full loads of product to the plant.

2. Blocking of carcass beef into primal cuts should be done well in advance of retail cutting. The blocking operation preferably should be done in the cooler by crews equipped with portable power saws which can easily be moved to the product.

3. To increase production at the cutting stations, two- or three-man crews should be used during peak periods. Meat rails should feed the primal cuts to the individual cutting stations.

4. Automatic wrapping machines, scales, label printers, and handwrapping stations designed for efficiency should be used in the packaging and pricing operation.

5. The selection cooler should contain enough fixed slot racks and gravity-flow conveyors to store all the peak day's production.

6. Shipping containers should have the following features: (a) Size and weight that permits easy handling, (b) a shape so they can be nested when empty, (c) ability of material to withstand rough handling and cleaning methods.

7. Delivery trucks should be equipped with self-contained refrigeration units.

8. All power equipment and cutting blocks should be thoroughly cleaned at least once a day, and perhaps even more often, to obtain at least 2 to 5 days of shelf life for fresh red meats.

9. The recommended temperature levels for the various storage and processing areas are as follows:

a. Storage cooler, 30° to 33° F.
b. Processing area, 32° to 40° F.
c. Selection cooler, 30° to 33° F.
d. Refrigerated truck, 28° to 31° F.
e. Store cooler, 32° to 34° F.
f. Retail display cases, 29° to 32° F.

Retail stores should be staffed with enough personnel to handle adequately the special order requests of the customers, to police and stock the display cases, to price mark and display prepackaged luncheon meats, and to take daily inventories of the meat display cases. It was also found that the retail-store meat backroom area could be reduced by over 50 percent when retail cuts of meat were supplied by a central plant.

Layout designs for central plants of low, medium, and high volume have been developed as a guide to the industry. These layouts permit a straight-through flow of the products, from receiving area to carcass storage area, to blocking area, to primal-cut storage area, to cutting area, to wrapping and pricing area, to line unloading area, to order-selection area, to bill-out area, and finally to shipping area.

The research results presented in this report will be revised and refined as more experience and information are obtained.

BACKGROUND

The meat department sales of retail food stores represented about one-fourth of the total annual food store sales of $54 billion in 1961.[1] Handling costs in the meat department are more than 1/4 of total store expenses because of the extra refrigerated equipment, supplies, and labor required. At present, most supermarket companies are processing fresh meat at each individual store into retail cuts that are weighed, priced, and packaged, ready for sale from self-service refrigerated display cases.

Considerable work has been done in the past 12 years by the U.S. Department of Agriculture and other researchers to improve the efficiency of self-service meat departments through development of improved methods, materials, equipment, and layouts. Dollar sales per man-hour in meat departments have moved steadily upward from about $20 in 1950 to $40 in 1962. Substantial further operational efficiencies appear to be limited in processing in the backroom of retail stores. Improvements in food-handling practices have led to reexamination of the feasibility of central handling and packaging of fresh meats.

Luncheon meats, produce, and bakery items are, in many cases, being packaged and priced for retail sale at central processing plants. Several large corporate chains and voluntary group wholesalers have centralized such operations as carcass blocking, boning

[1]Facts in Grocery Distribution, 1962 Edition, Progressive Grocer Magazine.

of rough cuts, and the ground meat operation. Ground meat is being packaged in bulk and in retail-size packages in central plants. Central processing plants are also packaging portion-control meat (each package containing portions of about equal size), both in frozen and fresh form, for institutional use and for limited sale in retail stores. Plants in producing areas are cutting up and packaging poultry in consumer units.

Central packaging and distribution of retail meat cuts is being extensively practiced in Europe, some plants serving as many as 100 stores up to distances of 100 miles. They do not use meat preservatives. One plant has been successfully supplying 30 stores with 100,000 packages a week, and was planning to expand within the next year.

In 1955, USDA researchers made a survey and analyzed the distribution practices of packers of prepackaged frozen meats (1).[2] It was concluded that freezing was not essential for the success of a central meat operation. Many frozen meat cuts were not well accepted by consumers. Handling costs for frozen meat were high.

Starting in 1959, studies were made of firms in this country which were packaging and distributing retail cuts of fresh meat from central processing plants. The majority of these firms were supplying retail stores that sold too low a volume to prepackage fresh meat profitably in the store.

Each of these central plants was processing for 3 to as many as 25 retail stores whose fresh meat sales varied from $200 to $1,500 a week. However, several of the concerns studied were processing all the retail packages for stores with weekly meat sales as high as $10,000 to $12,000. Usually, no more than a few stores of this size were being supplied by the central plant.

An over- or under-supply of retail cuts, short shelf life, and discoloration were the greatest difficulties encountered in central meat plant operations. No effective procedures were in use to predict sales or to control inventories, and frequently many packages of meat in unsalable condition were found in the retail stores.

During the past several years, researchers from both industry and government have been trying to extend the shelf life of meat. Findings in research with preservatives, radiation, and special packaging materials give indications of success; but there are many problems which limit their immediate application in the retail trade.

Preliminary research shows that costs of central packaging of fresh meat can be reduced materially by better utilization of labor and by the use of more efficient machinery, equipment, and layout of processing lines.

USDA researchers designed and installed improved operational procedures, inventory control systems, scheduling systems, and layouts in three central plants. Standard industrial engineering procedures and marketing research techniques were employed to develop and project operational systems which can be used in the design and operation of larger volume central meat plants.

The objective of this report is to aid the food industry in evaluating central fresh meat processing operations, and to provide fundamental guidelines for those who plan to build such central plants. Data presented in this report will be revised and refined when more experience and information are obtained from larger scale operations as they come into existence.

The labor times used in this report are developed for budgeting purposes and are not intended for use as labor standards. Equipment costs were obtained on a single-unit purchase basis. They do not reflect price differences in different regions of the country.

[2]Underlined figures in parentheses refer to items in Literature Cited, p. 54.

PLANT LAYOUT

A central meat-packaging plant's operation involves ordering, processing, order selecting, billing out store orders, and delivery scheduling. Central fresh meat processing is now being done either in a backroom of an individual retail food store (servicing several stores), or in a separate building devoted to processing.

The total volume of meat distributed to retail stores by a central plant may be insufficient to justify the costs of a separate building. Instead of constructing a separate building, it may be more feasible to package the meat in an existing retail store or in one that is to be built.

A central packaging operation in a retail store is, in most cases, not as efficient as one in a separate structure, because of inherent physical limitations. It is difficult to design a supermarket layout which includes the meat processing, storage, selection, bill-out, and shipping areas so as to provide a smooth, continuous flow of the product from the receiving area to the shipping area. Needs of other supermarket departments for space impose serious limitations on an attempt to integrate a central fresh meat plant into a store.

The design of a small central meat-packaging plant built in conjunction with a retail store is shown in figure 1. Most store meat backrooms are long and narrow, which limits the plant to a straight-line flow layout. A disadvantage of the layout is the distance separating the receiving and shipping operations, making it more difficult for the plant manager to keep close watch on these two important areas.

Constructing a central plant for fresh meat packaging as a separate building has the following advantages over a plant in the backroom of a retail store:

1. The plant can be more centrally located in relation to the retail stores that it is to service.

2. The layout can be designed more easily for the best arrangement of work areas.

3. Equipment can be used more efficiently.

4. It is easier to expand the plant.

5. It is more economical in land costs.

A large-volume central-plant layout, shown in figure 2 (in the center spread, page 38), is designed to handle production volume valued at $130,000 to $250,000, based on an 8-hour shift and a 40-hour workweek. A peak production volume of $35,000 to $60,000 would occur on the Wednesday or Thursday shift, and the plant was designed to handle that peak in a regular 8-hour shift without overtime.

Receiving Area

When the volume of the central plant is small, all shipments can be received at one door. Meat rails extend to the door to facilitate the receiving of beef. The floor level of the receiving area is at truckbed height.

In a large-volume central plant, as shown in figure 2, two receiving doors are advisable, to minimize the time spent in receiving. Meat rails with scales are installed at both doors to permit simultaneous receiving of beef from two trucks. A 10-foot overhanging roof is provided for protection in inclement weather. Backup pads are permanently installed on receiving doors to aid in maintaining the temperature in refrigerated trucks.

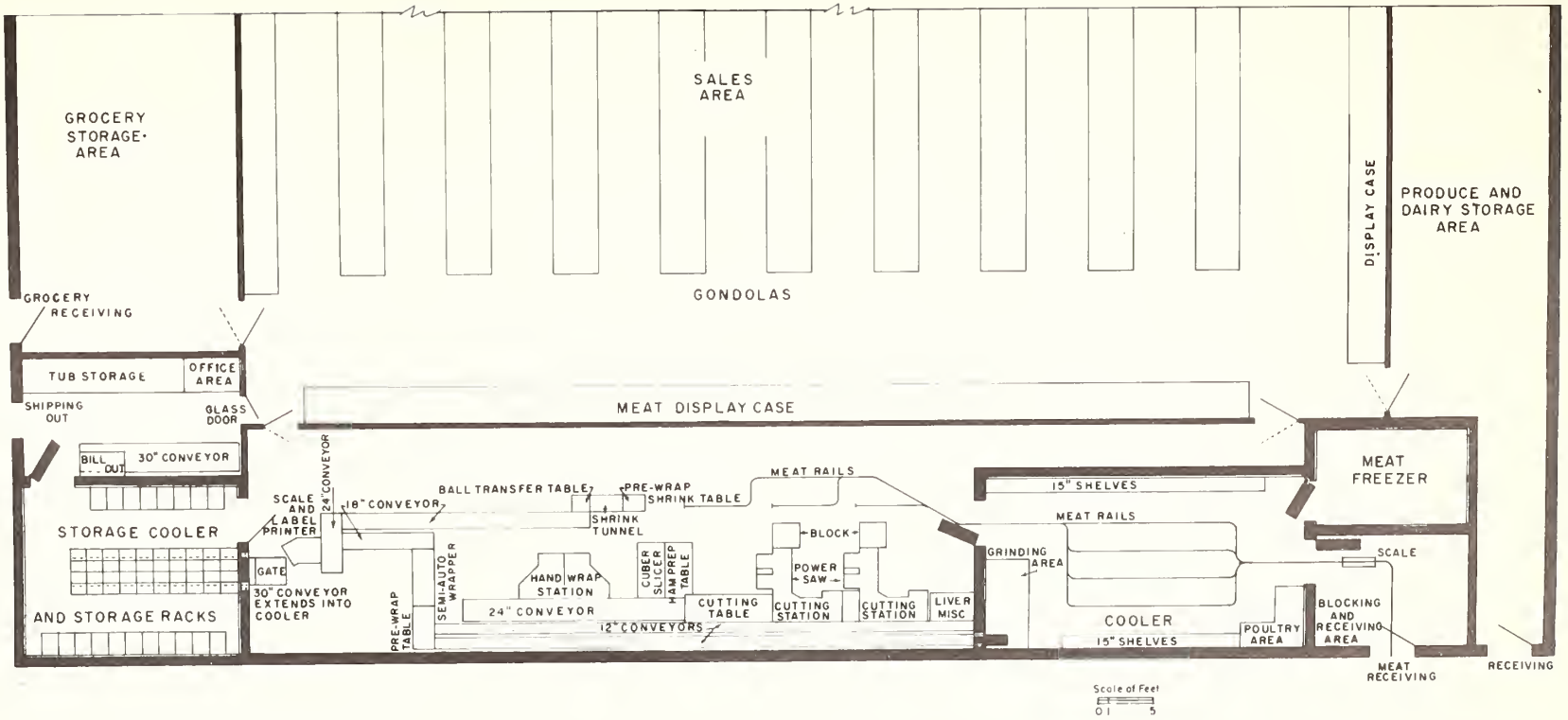

Figure 1.--A small-volume central meat-packaging plant built in conjunction with a retail store.

An unloading ramp extends from the shipping area into the meat receiving area. If necessary, this ramp can be used to receive prepackaged luncheon items which are stored in the order-selection cooler. Also, there may be times when it would be used for shipping purposes.

Meat Storage Cooler

In a medium-volume central plant, as shown in figure 3, the cooler is equipped with 100 feet of rails, which is enough space for hanging 80 sides of beef.

In a large-volume central plant, as shown in figure 2, the meat cooler has 252 feet of actual storage rail and allows ample space for hanging over 200 sides of beef at one time. The poultry storage area is near the receiving and processing area. Storage racks are along both walls, running the length of the cooler, with 3 1/2 feet of aisle space between the racks and the meat rails. The aisle width is sufficient for easy movement of dollies and handtrucks from one end of the cooler to the other. The ground meat processing area is at the far end of the cooler, as shown in figure 2. Ground meat is moved to the automatic wrapping machine through a pass-through window on 30-inch skate-wheel gravity conveyors.

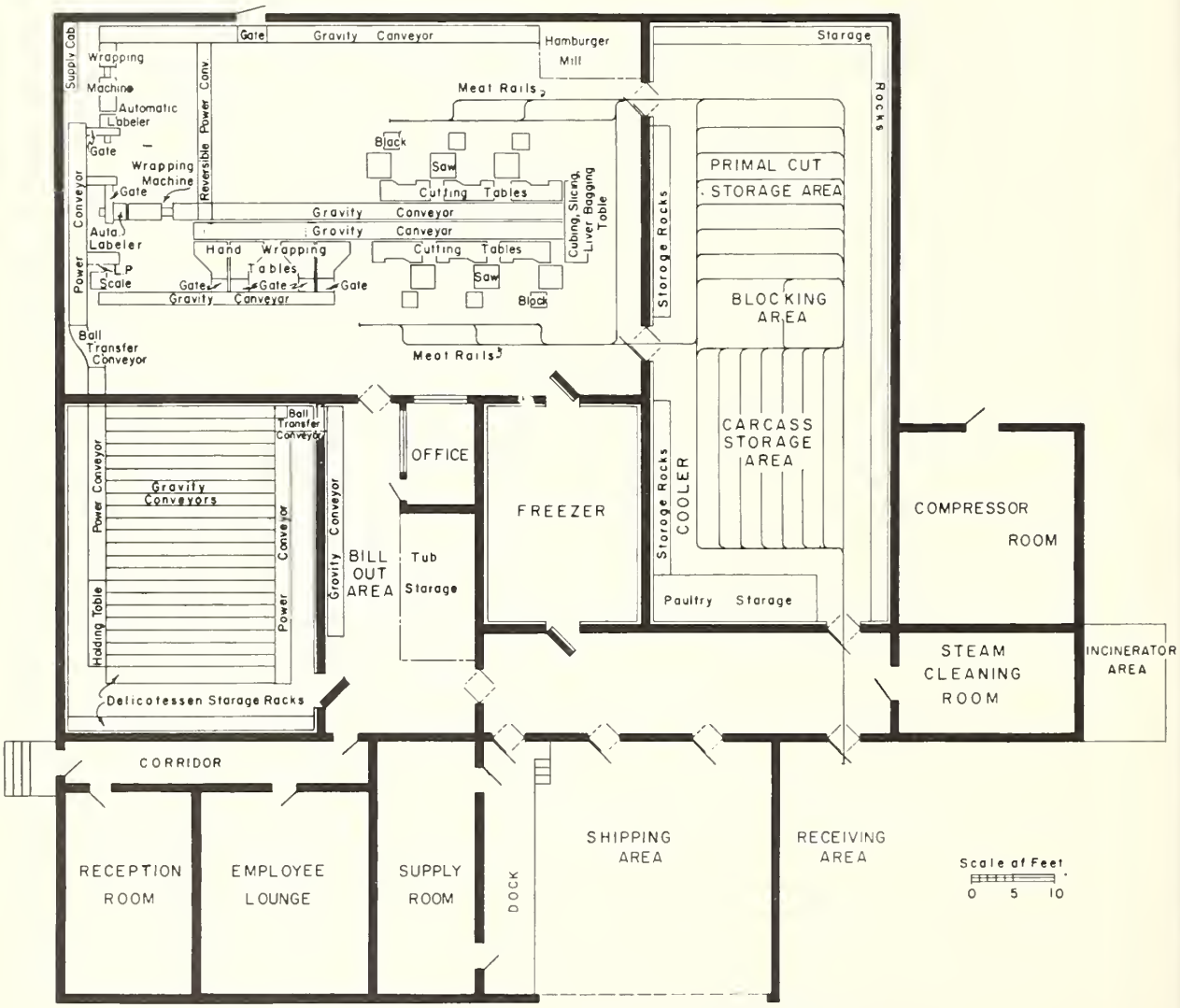

Figure 3.--A medium-volume central meat-packaging plant.

Blocking Area

In a central plant at a retail store, the blocking is done in the receiving area after all shipments have been received. (2) Beef is then brought out from the storage cooler as needed and cut into primal cuts, treed,[3] and returned to the meat storage cooler.

In a central plant in a separate building, the blocking area should be located approximately in the center of the meat cooler, as shown in figure 4, to eliminate backtracking and to insure that the product is used on a first-in, first-out basis.

BN-19256

Figure 4.--Blocking area in large operation.

Cutting Area

Gravity skate wheel conveyors are used to transport the product from the cutting tables to the wrapping area (fig. 5). The ground meat operation is located in the cooler, but can be located outside it if low temperatures are maintained in the processing area.

Two 12-inch gravity conveyor lines feed from the cutting area to the wrapping area. The pans can be placed lengthwise on the separate conveyor lines, allowing the conveyor along the wall to be used as a special-purpose line, feeding ground meat from the cooler to the semiautomatic wrapping machine. The conveyor lines can be used also as a 30-inch line, which would give more storage room between the cutting and wrapping machines, since the pans can be positioned lengthwise across the two 12-inch conveyors.

[3] "Treeing" beef consists of placing blocks of beef on hooks attached to a vertical bar, hanging from a wheel that runs along a meat rail.

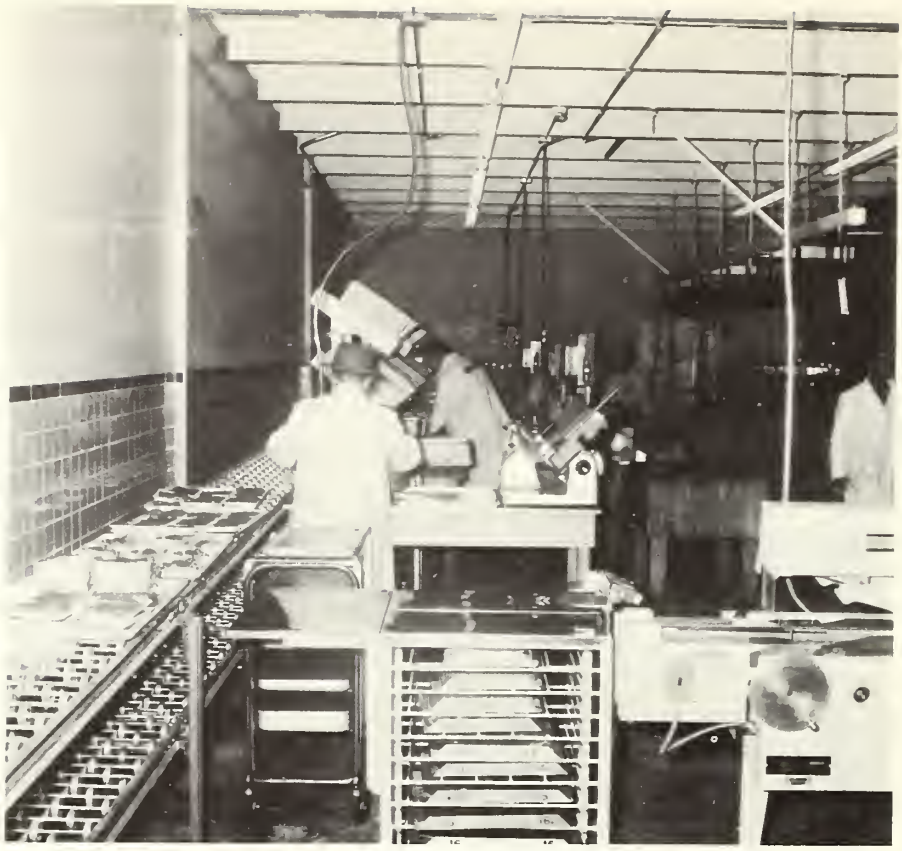

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Figure 5.--Cutting area.

Wrapping Area

As shown in figure 3, in a medium-volume plant both conveyors feed to the semi-automatic wrapping machine. Packages that cannot be wrapped on the machines are placed by the machine operator on a 24-inch conveyor line which feeds to two right-angle handwrapping stations. Wrapped packages from both the machine and handwrapping stations are fed by conveyors to the pricing station.

In a larger volume plant, as shown in figure 2, two parallel 24-inch gravity conveyors bring the product from the cutting area into the wrapping area. One of the conveyor lines feeds the product toward the automatic wrapping machines, while the adjoining line moves products to be handwrapped at the handwrapping station. Each machine wrapper feeds the product into an automatic labeler, where it is weighed, priced, labeled, and transported by power conveyor to the selection cooler. Handwrapped items move from the wrapping tables on a skate-wheel gravity conveyor which feeds the product to the automatic scales and label printers. The weighed and priced packages are moved from the scales to the selection cooler by power conveyors.

Selection and Bill-Out Area

Each wrapped, weighed, and priced package moves by means of a small power belt conveyor from the automatic labeler onto a main power belt conveyor and is transported into the selection cooler.

In the central plants shown in figures 2 and 3, gravity-flow conveyors are provided for storing the fast-moving items. Slow-moving items are stored in fixed selection slots.

The product moves by conveyor to selection area to bill-out area, and by handtruck to the delivery truck.

Shipping Area

The floor of the shipping dock should be at truckbed level to facilitate loading. After the store orders have been billed out, they are either stored in the cooler or loaded directly into the delivery truck. The shipping door should be lined with backup pads, as shown in figure 6, to maintain a low temperature within the truck during loading.

BN-13580

Figure 6.--Trailer backed against foam rubber (indicated by arrows) at loading door.

The shipping area is entirely enclosed to facilitate the loading operation during inclement weather. The shipping docks are long enough to load three delivery trucks at a time. The loading dock is located near the storage area, to minimize travel distances. This area can be used also for receiving prepackaged delicatessen and processing supplies.

Office Area

The office should be so located that the plant manager can see all the major processing areas from his desk. As shown in figure 7, there should be large windows in the walls of the office, so the plant manager can view the receiving, blocking, boning, cutting, wrapping, pricing, bill-out, and shipping operations from the office.

BN-19254

Figure 7.--Office located in central meat plant.

ANALYSIS OF EQUIPMENT AND WORK PROCEDURES

In a central meat-packaging plant, it is economically feasible to use specially designed equipment, and work methods to reduce total operating costs substantially.

Receiving, Storage, and Blocking

Preferably, all meat products that are to be processed and distributed by a central plant should be received during the first part of the week. This permits a minimum number of orders and full delivery loads from the packers, and makes work scheduling easier

for the plant manager. Coolers should, therefore, be designed with ample storage facilities, allowing the central plant to receive only one or two shipments per week.

Since approximately 60 to 70 percent of the weekly sales occur on Thursday, Friday, and Saturday, most of the blocking operation should be completed by Wednesday. Two or more two-man blocking crews can be used. For speed, blocking should be done on the meat rail with ceiling-suspended power saws (2). One man on the crew should operate the power saw, while the second man trees the primal cuts according to type of cut. Also, the second man of the crew pushes each multiple rail hook (tree hook) of primal cuts to the appropriate storage meat rail and sees that an ample supply of empty meat trees is always on hand. A two-man crew could switch jobs after some specified amount of work, in order to reduce fatigue.

Cutting

Each cutting station should be designed to accommodate either a two- or three-man crew (fig. 8). In large operations, team cutting is usually more productive and provides a better balanced processing line. The size of the cutting crew depends upon the volume of product required during a particular 8-hour shift. Probably a two-man crew would be scheduled for the first part of the week, and a three-man crew for the heavy-volume production later in the week.

BN-19262

Figure 8.--Cutting and traying station.

Each cutting station should have enough rail space for storing up to four trees of primal cuts, thus reducing trips to the cooler (fig. 9). Also, a holding area should be provided at each cutting station to help in keeping like items together. When a substantial amount of similar items has been accumulated, they can then be passed on to the wrapping stations.

Packaging and Pricing

Wrapping machines combined with automatic scales and labelers should be used to the maximum, because of their high production capacity (fig. 10). In a high-volume central plant, conveyor lines, with switches, can be set up so that the product can be diverted from one automatic wrapper to another in order to balance the work load properly. Enough storage area should be provided at each automatic wrapper so that the machine operator can bypass some of the product in order to wrap like items in one batch. This arrangement makes for less adjusting of the automatic wrapper.

Handwrapping stations should be designed with all supplies and wrapping tools easily accessible to the wrapper. (3) The USDA wrapping table shown in figure 11 is an example of an efficient handwrap station. A bypass storage area also should be provided at each handwrapping station to help in keeping like items together. One automatic scale can usually handle the volume of product from four or five well-designed handwrapping stations.

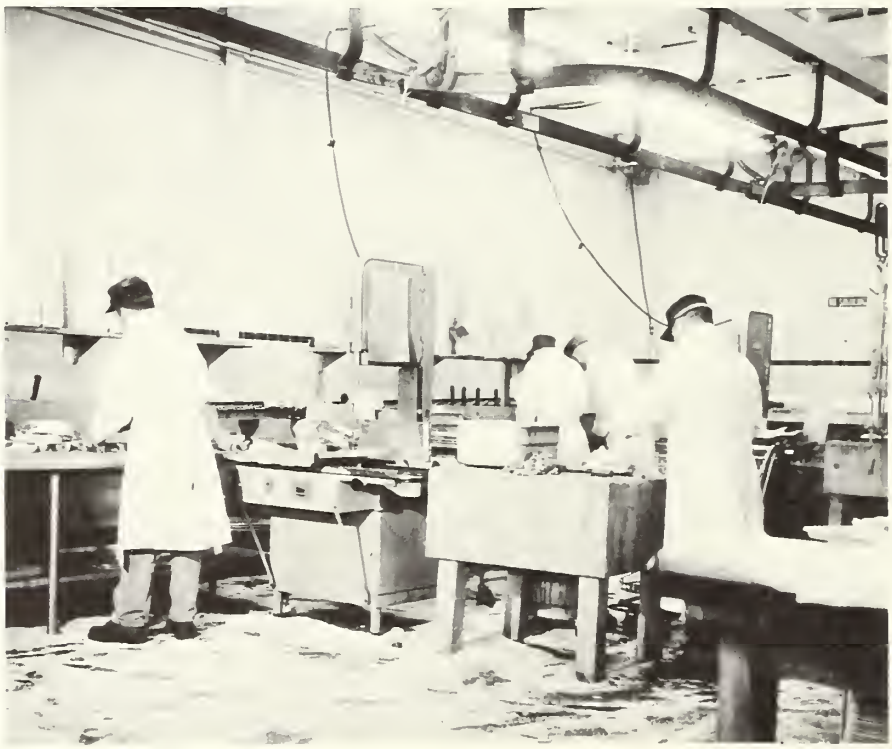

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Figure 9.--Meat rails extending to each cutting station.

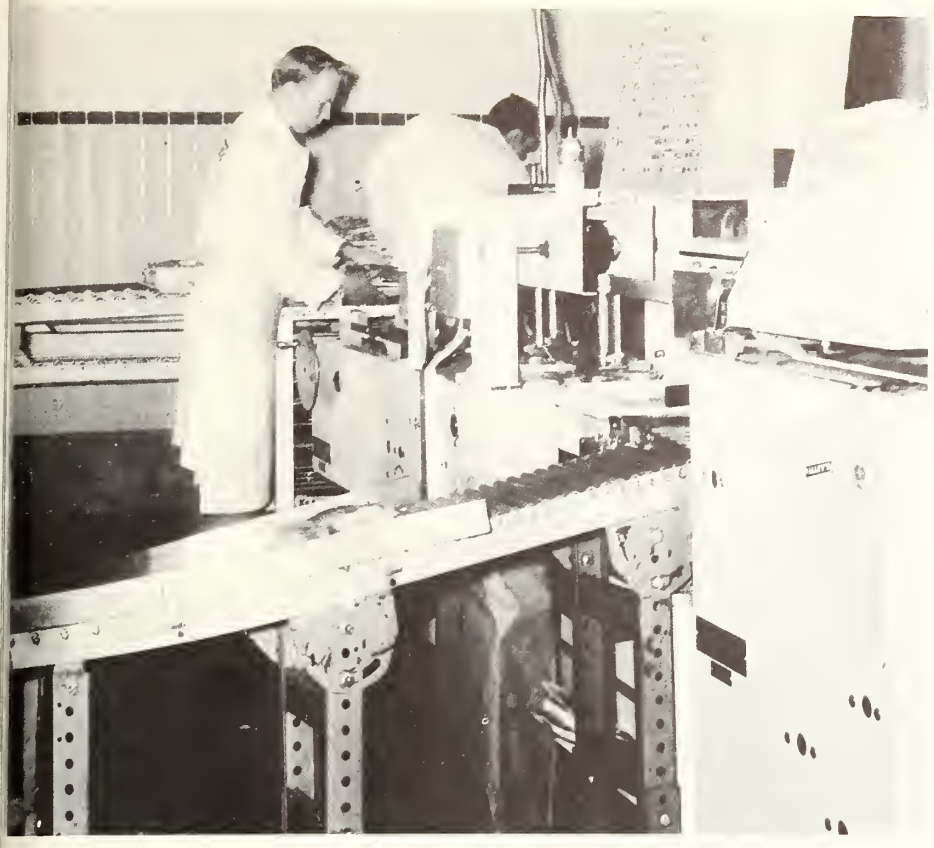

Figure 10.--Wrapping machine combined with automatic scale.

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igure 11.--USDA-designed handwrapping table.

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Selection and Bill-Out

The selection cooler should contain enough fixed slot racks for storing all of the peak day's production. Items should be placed in the slots and selected according to the sequence of their listing on the store order forms. A special crew is used in the selection area to take the product from the conveyor and store it in the proper slots (fig. 12).

In a large-volume central plant, gravity-flow conveyor lines can be provided for storing the fast-moving items. The gravity-flow conveyors are stocked from the rear, and the selection is done from the front, as shown in figure 13. This system assures that the product will be selected on a first-in, first-out basis. Slow-moving items are stored in fixed selection slots.

Team work may be used also in selecting store orders. For instance, one man may select the high-volume items while a second man selects the slow-moving items. The selecting is done for one store at a time and, as the order is being selected, it moves by power and gravity conveyors into the bill-out room. Several types of bill-out systems can be used, but, regardless of the system, this operation can be a major bottleneck in a central-plant operation.

In a small-volume plant doing $15,000 to $30,000 weekly volume in fresh red meats and supplying from three to six retail stores, the bill-out operation can be performed effectively by using electric adding machines.

BN-19258

Figure 12.--Stocking gravity-flow conveyors from rear (4).

BN-19261

Figure 13.--Selecting store orders from gravity-flow conveyors (4).

As the volume of the central plant and the number of stores serviced increase, use of an electric adding machine in the bill-out system becomes more and more inefficient, and other methods of billing the stores must be used to speed up the operation.

The few concerns in the country that are packaging retail cuts of fresh meat from a central plant bill the stores for each package at regular retail price. A percentage discount is then given to each store based on management's policy. In a high-volume operation, it might prove feasible to bill out all the high-volume movers by the bulk method. As an example, all ground meat packages being shipped to the store could be weighed at one time and charged to the store on the basis of the total retail price.

After all the orders have been billed out, the tape is sent to the office, where each store's total is entered in the store ledger journal. The type of layout for the bill-out area would depend on the volume and the number of stores involved. When a central plant is servicing many retail stores, it is necessary to have several separate bill-out lines in order to handle the volume efficiently (fig. 14).

A bill-out line could be set up for the high-volume movers and another for the low-volume movers. To balance the bill-out operation with the low-volume line, it might be necessary to place two bill-out stations in the high-volume line. After the store's order has been billed out, it is placed in the delivery truck for shipment to the store.

BN-19257

Figure 14.--Bill-out station, showing two billing lines (4).

Shipping Containers

The container needed for shipping and storage of the processed retail cuts should have the following attributes: (1) Convenient in size; (2) lightweight but extremely durable; (3) designed for nesting; and (4) made of material that can stand rough handling and cleaning methods.

One of the first decisions to be made is determination of the size and type of container to use. The maximum number and weight of the packages that can be handled reasonably by one man without causing undue fatigue is probably the major factor in determining the size of container to use. It was decided by researchers that a man should not be asked to handle over 50 pounds in a shipping tub. Using this assumption, the size of the container was determined by considering the following factors: (1) Size of trays in which the majority of the products are packed; (2) average weight of packages; and (3) damage due to weight of packages in container.

In most cases, the highest percentages of the product will be packed in 2S and 4S trays. The 2S tray is 5 1/2 inches wide by 8 inches long. One layer of 10 2S trays will fit in a container having inside dimensions of 18 inches by 28 inches. The number of layers that a container can hold depends on the height and weight of the product. For example, club steaks packaged in 2S trays take up about three-fourths of an inch for each layer; therefore, a container 8 inches deep will hold 8 layers, or 80 packages.

Another factor to be considered is the effect that the weight of the product in the container has on the bottom packages, in relation to package or product damage. On some items, it may be necessary to place cardboard dividers between the layers in order to protect the product from being damaged in shipment.

It probably would be necessary for most firms to use two sizes of containers, varying in depth for different products, since some items, such as cut-up chicken and roasts, range in height from 3 to 7 inches (fig. 15). These items would require a shipping container at least 8 inches deep to get two layers of the product into the container.

Material used in construction of the shipping container must be extremely durable and able to withstand rough handling without being damaged. Also, the containers probably would be cleaned by a high-pressure steam or hot-water system, so it is necessary that the material used in them be capable of withstanding high temperatures. To facilitate handling and to conserve storage space, the containers should be designed for nesting.

Delivery Trucks

In medium- and large-volume operations, it is probably most economical, in servicing the stores, to use a refrigerated "bobtail" truck with a truckbed length of about 18 feet and inside width of about 6 1/2 feet.

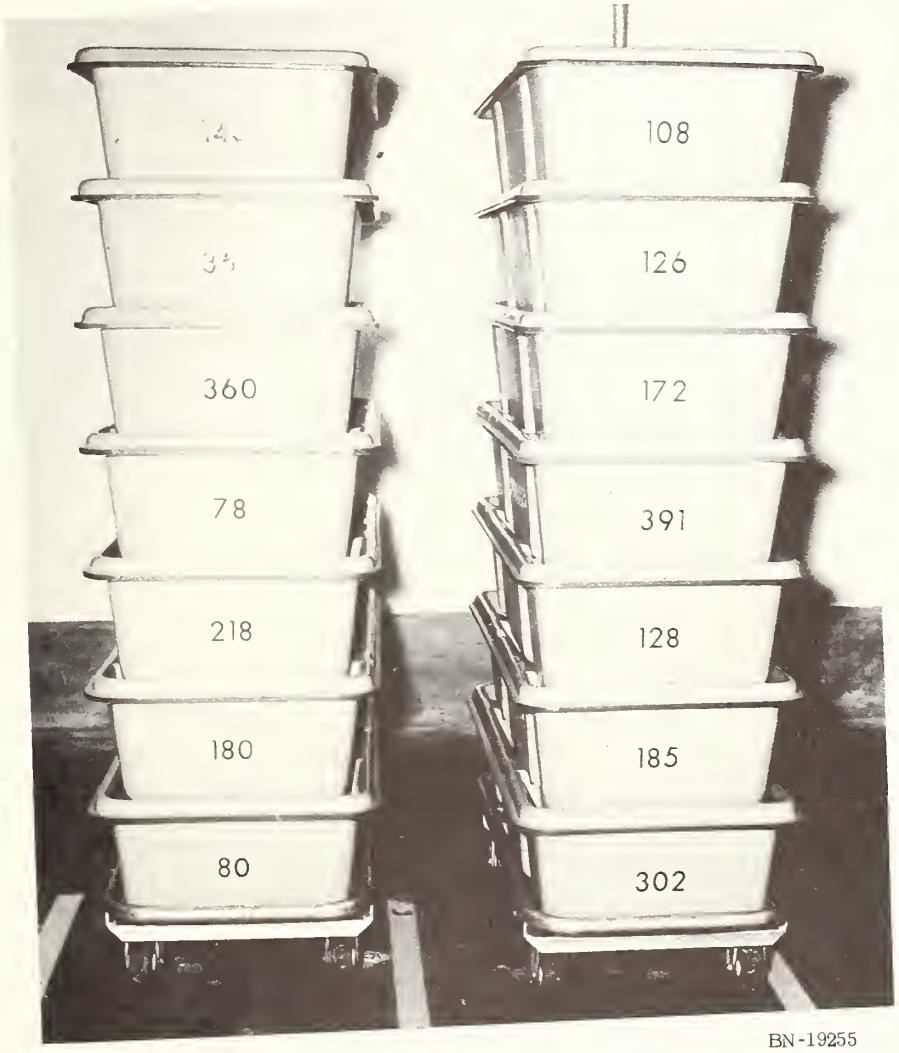


Figure 15.--Shipping containers for prepackaged meat.

A "bobtail" truck has the capacity for holding a reasonably large order while still being fairly maneuverable in city and suburban traffic. However, it might be more economical to use a semitrailer truck, especially if 20 or more stores are to be serviced.

It is possible that both semitrailer and "bobtail" trucks would be used in a given operation, if the volume of the stores serviced varied widely and if the stores were in urban and suburban areas (fig. 16). In any case, the size and number of trucks should be based on the total volume of the stores to be serviced, along with the number of delivery runs to each store that a truck is required to make during the day of peak production.

Unloading methods at the stores depend upon the type of truck, type of shipping containers, and facilities available at the retail stores. Some of the retail stores may not have truckbed-height docks; therefore, the order could be unloaded by either conveyors, chutes, or a truck equipped with a hydraulic-type tailgate. The orders can be transported into the stores' holding coolers by pallet jacks, handtrucks, four-wheel dollies, or conveyors, depending upon equipment and operating conditions.

BN-19253

Figure 16.--Two types of delivery trucks: "Bobtail" (left) and semitrailer.

Sanitation and Refrigeration

It is entirely feasible to package retail cuts of fresh meat at a central plant when a shelf life of 2 to 5 days is realized. The work done thus far in centralized operations indicates that by using proper sanitation and by holding temperatures near the freezing point, a shelf life of 2 to 5 days can be attained on most meat cuts, with ground meat being limited to approximately 2 days.[4] Research is continuing in order to determine more precisely the sanitation, refrigeration, and other procedures that should be followed in order to attain maximum shelf life.

A concentrated effort by management is needed to teach employees to use good sanitation procedures. Cutters and wrappers should clean their work stations after each operation. All power equipment and cutting blocks should be thoroughly cleaned. A portable steam unit is an effective method to use for cleaning the equipment and the cutting

[4]Unpublished research conducted by the University of Missouri and W. R. Grace & Co., Cryovac Division, substantiates these findings.

blocks, although some researchers suggest that hot water under pressure is even more effective than steam.

Floors should be kept clean. Trash cans or bins should be in convenient locations throughout the plant, and employees trained to use them. Increasing production by combining modern equipment with the best practical layout cannot be attained when "sloppy" work methods and poor housekeeping principles are permitted in a central plant.

Good sanitation can drastically reduce the bacteria count, thereby adding to the shelf life of fresh red meats; but another factor, equally or more important, is temperature. Bacteria become less active as the temperature is lowered; therefore, low temperatures are extremely important in extending the shelf life of fresh meats. Recommended temperature levels for the various storage and processing areas are:

1. Carcass meat, 30° to 33° F. in storage cooler.
2. Processing area, 32° to 40° F.
3. Selection cooler, 30° to 33° F.
4. Refrigerated truck, 28° to 31° F.
5. Store cooler, 31° to 34° F.
6. Retail display cases, 29° to 32° F.

The temperature of the coolers should be held low so as to keep the product as cold as possible without actually freezing it. Therefore, the refrigeration equipment should be capable of maintaining these recommended temperatures during the peak periods of processing when the cooler doors are frequently opened and closed.

Refrigeration in the delivery trucks should have the capacity to consistently hold the meat near the 32° F. level. This temperature is affected by the number of times the doors are opened and by the outside temperature, so it may be necessary to set the thermostat lower than 32°.

The store's display cases should be adjusted within the range of 29° to 32° F. Defrost cycles of the display cases should occur in the early morning before the delivery is scheduled to arrive. Holding the display case at 29° does not ordinarily freeze the product, even though it may remain in the case for 3 days, provided covers are not placed over the case at night.

RETAIL MEAT DEPARTMENT OPERATIONS

The meat department of a retail store should have adequate personnel (1) to maintain personal contact with the customer; (2) to service orders that require special handling; (3) to keep the meat in the case properly displayed; (4) to rewrap or remove damaged packages; and (5) to take daily inventories.

In a department that receives its meat from a central processing center, those responsibilities should be assigned to a meat cutter. He should have a pleasing personality and have the ability to help customers with problems relative to meat preparation, cooking, and serving.

The backrooms of retail stores supplied by a central plant are smaller because of the elimination of most of the processing and because fewer personnel are required. Shown in figure 17 is the processing backroom of a meat department for a store with a weekly meat volume of 15 to 20 thousand dollars. The processing area may, of course, vary slightly from store to store, but the size of this backroom was determined according to good layout and flow arrangements using modern equipment and an efficient materials-handling system. (5)

Figure 18 shows a meat department designed by the researchers for a retail store where processing at the store level is eliminated. The cooler area has been reduced to about 60 percent of the size needed in the conventional backroom. The only items that will be placed in the cooler when the store is being serviced from a central plant will be

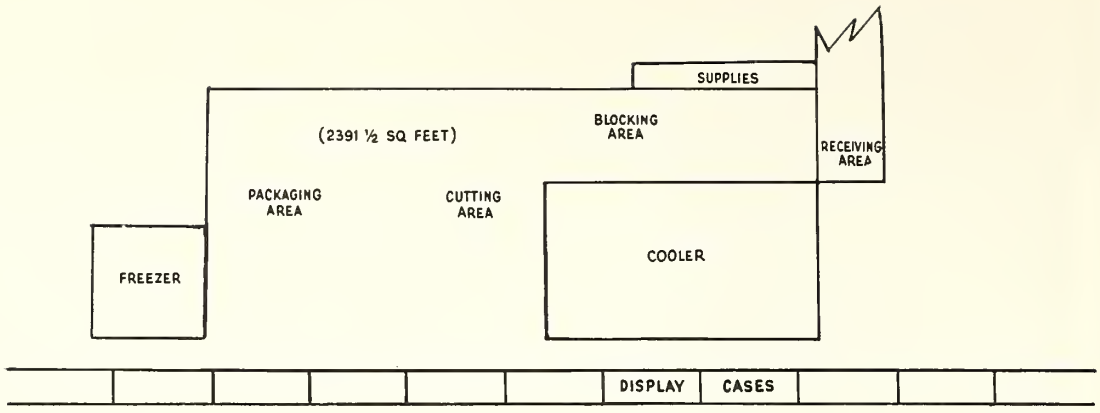


Figure 17.--Conventional meat backroom area for a medium-volume retail store.

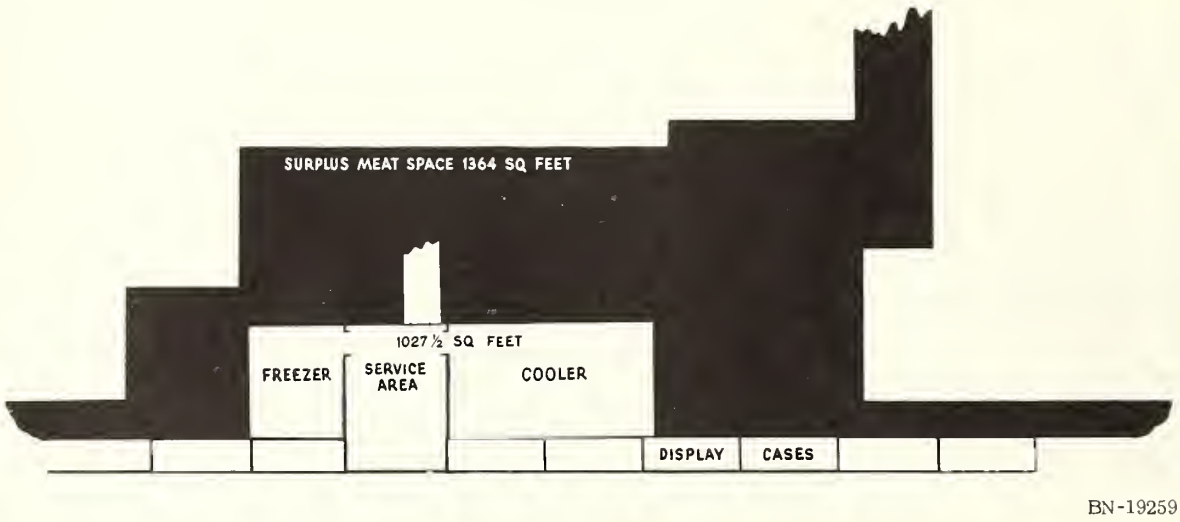


Figure 18.--Illustration of savings in meat backroom space for a store with volume of $15,000 to $20,000 when the retail store is serviced by a central meat plant.

a few primal cuts which are used to take care of special orders, and for temporary storage of part of the store's orders that are received daily from the plant.

The freezer probably would remain the same size, since about the same amount of products would be stored there with either method of operation.

Customers need to be assured that quality meat is always available, and, if necessary, that it can be cut to their special requirements. To help demonstrate activity and service in the meat department, the processing area can be open to the customer's view. A window might be located in the cooler wall so the primal cuts can be seen from the sales area. Only a minimum of inexpensive equipment is needed in an operation of this type. The butcher would be provided with a block or small cutting table and some hand-cutting tools for handling special orders and for reworking some of the meat packages. Also provided would be some sheet film and hand irons, a few labels, a small mill, a slicer, and a cuber for special orders and rewraps. These work areas would also be used for pricing some delicatessen items and for other jobs related to servicing the meat displays.

Stocking of cases usually would be done early in the day, and the only work needed at the cases during busy sales periods would be some restocking of a few fast-moving

items, policing, straightening, and the like. Therefore, it might be possible to eliminate the rear service aisle without inconveniencing the customers, and thus save additional space.

Depending on the volume of the store and the weekly sales pattern, the scheduling of store help may be such that some slow sales periods would not require a meat cutter to be present in the store. This would make it easier to schedule the proper number of cutters during busy sales periods when they would be needed to help maintain the case and handle special orders.

Figure 19 shows a possible layout of a retail store meat department serviced by a central plant. It was estimated that a retail meat department for a store of this volume

Figure 19.--Layout of a retail store meat department when serviced by a central plant.

($6,250 weekly) would require about 2,390 square feet of floor space. A meat department of the same volume, supplied by a central processing plant, would require only about 1,030 square feet, a saving in floor space of over 50 percent. (6)

COSTS OF CENTRALLY PROCESSING FRESH MEATS

Several factors tend to favor centralized meat processing; however, some of them are difficult to evaluate because of variations in conditions under which food firms operate. These factors are discussed here under the general headings of construction, equipment, labor, and special cost considerations.

Potential direct savings from processing fresh meat products at a central plant rather than at the retail store can be predetermined fairly accurately. The following factors should be considered in a cost evaluation of central fresh meat processing:

1. The equipment presently used in retail stores is often not used to capacity, and must necessarily consist of small-volume units. Centralized processing eliminates the need for most of the present equipment in retail outlets, provides for more efficient use of the equipment due to the higher volume, and permits the use of highly specialized or high-volume production machines that are not economical in a retail store.

2. Elimination of processing space at the retail store by the concentration of these facilities into one plant can reduce floor space requirements considerably.

3. Land and building costs can be lower for the centralized operation. Central plants can be constructed on less costly land and with less costly construction than retail stores located in high-cost shopping centers.

4. Layout and arrangement of work areas in central plants, designed for production only, can often be made more efficient than those in a retail store.

5. Efficient labor scheduling is one of the chief advantages of centralized operations. Specialization is possible, and less changing of jobs and less make-ready and put-away time are required. Also, specialization of personnel is increased by putting sales-oriented people in the retail store and production-oriented people in the central plant.

Many of the costs shown in this section are projections beyond the volume level of existing plants, and, therefore, are tentative, for use in comparisons of the two systems and not as a definite cost analysis of central meat plant operations. Labor, equipment, and construction costs vary in different regions and for different operating methods, and should be modified in line with local conditions when applied to specific operations.

Costs used in this analysis are based on the assumption that both equipment and construction are new. However, most construction and equipment costs for a central meat plant will normally be additional costs, because most of the stores are already in existence and have been processing meat in their own backrooms. Even so, equipment now in the retail stores can often be used by the central plant. In addition, much of the space occupied by the conventional meat backrooms can be allotted to other departments. The cooler, freezer, and processing area in some older stores may be inadequate for retail-level processing, but may be adequate for stores serviced by a central plant.

In this report, construction, equipment, and labor costs were determined for central-plant operations designed to produce $37,500, $75,000, and $250,000 in total retail meat sales per week. These volumes include luncheon meats and other packaged meats which would be handled and distributed by the plant but not packaged and processed there. Layouts of plants with these volumes are found in the plant layout section of this report.

Construction Costs

The following calculation should be used only as a guide in comparing total construction costs for operations of the three different volumes:

A. Construction costs for a central meat plant with a $75,000 weekly volume:

		Dollars
1. Cost of building (shell):		
12,774 sq. ft. x $8.00 per sq. ft.		102,192
2. Cost of coolers (meat and selection coolers):		
First 2,800 cu. ft. x $1.10 per cu. ft.	3,080	
Remaining 28,390 cu. ft. x $.74 per cu. ft.	21,008	
Total cost for 31,190 cu. ft. of cooler area		24,088
3. Cost of refrigerating the processing and bill-out area:		
First 2,800 cu. ft. x $1.10 per cu. ft.	3,080	
Remaining 32,360 cu. ft. x $.74 per cu. ft.	23,946	
Total cost for 35,160 cu. ft. of processing and bill-out areas		27,026
4. Cost of freezer:		
First 2,240 cu. ft. x $1.63 per cu. ft.	3,977	
Remaining 5,360 cu. ft. x $1.09 per cu. ft.	5,842	
Total cost for 7,600 cu. ft. of freezer area		9,819
Total construction costs of central plant		163,125

B. Construction costs for a $6,250 weekly volume retail store meat backroom when serviced by a central meat plant:

1. Cost of backroom (shell):		
332 sq. ft. x $8.00 per sq. ft.	2,656	
2. Cost of cooler:		
960 cu. ft. x $1.10 per cu. ft.	1,056	
3. Cost of freezer:		
640 cu. ft. x $1.63 per cu. ft.	1,043	
Construction costs for one backroom	4,755	
4. Construction costs of backrooms for 12 retail stores with total weekly volume of $75,000	57,060	
Total construction cost of central plant plus retail stores served		220,185

C. Construction costs for retail store meat department with $6,250 weekly volume when served from conventional backroom:

1. Cost of backroom (shell):		
1,080 sq. ft. x $8.00 per sq. ft.	8,640	
2. Cost of cooler:		
2,400 cu. ft. x $1.10 per cu. ft.	2,640	
3. Cost of freezer:		
640 cu. ft. x $1.63 per cu. ft.	1,043	
Construction costs for one backroom	12,323	
4. Construction costs of backrooms for 12 retail stores with total weekly volume of $75,000:		
$12,323 x 12 stores		147,876

Construction costs for a central plant to service retail stores with an average weekly volume in meats of $6,250, are shown graphically in figure 20. The size of the central operation, as shown in the chart, ranges from $37,500 to $250,000 a week. Construction costs for any volume within this range can be interpolated from this graph.

To use the chart, assume a central plant is to service 12 stores with an anticipated total weekly volume of $75,000. To find the estimated construction costs, refer to figure 20 and follow the $75,000 line vertically until it intersects the sloped line titled "conventional method." At this point, the total construction cost of $147,876 is read on the vertical axis. Second, follow the $75,000-volume line vertically until it intersects the sloped line titled "central plant method." At this point, the central plant construction cost of $220,185, which also includes the construction costs of the retail stores, can be read from the vertical axis. Therefore, in a $75,000 weekly volume operation the construction cost for a central operation would be $72,309 greater than it would if the processing had been done at the retail stores in conventional backrooms.

Calculations of construction costs for all other weekly volume levels discussed in this report can be found on pages 56 through 59 of the appendix.

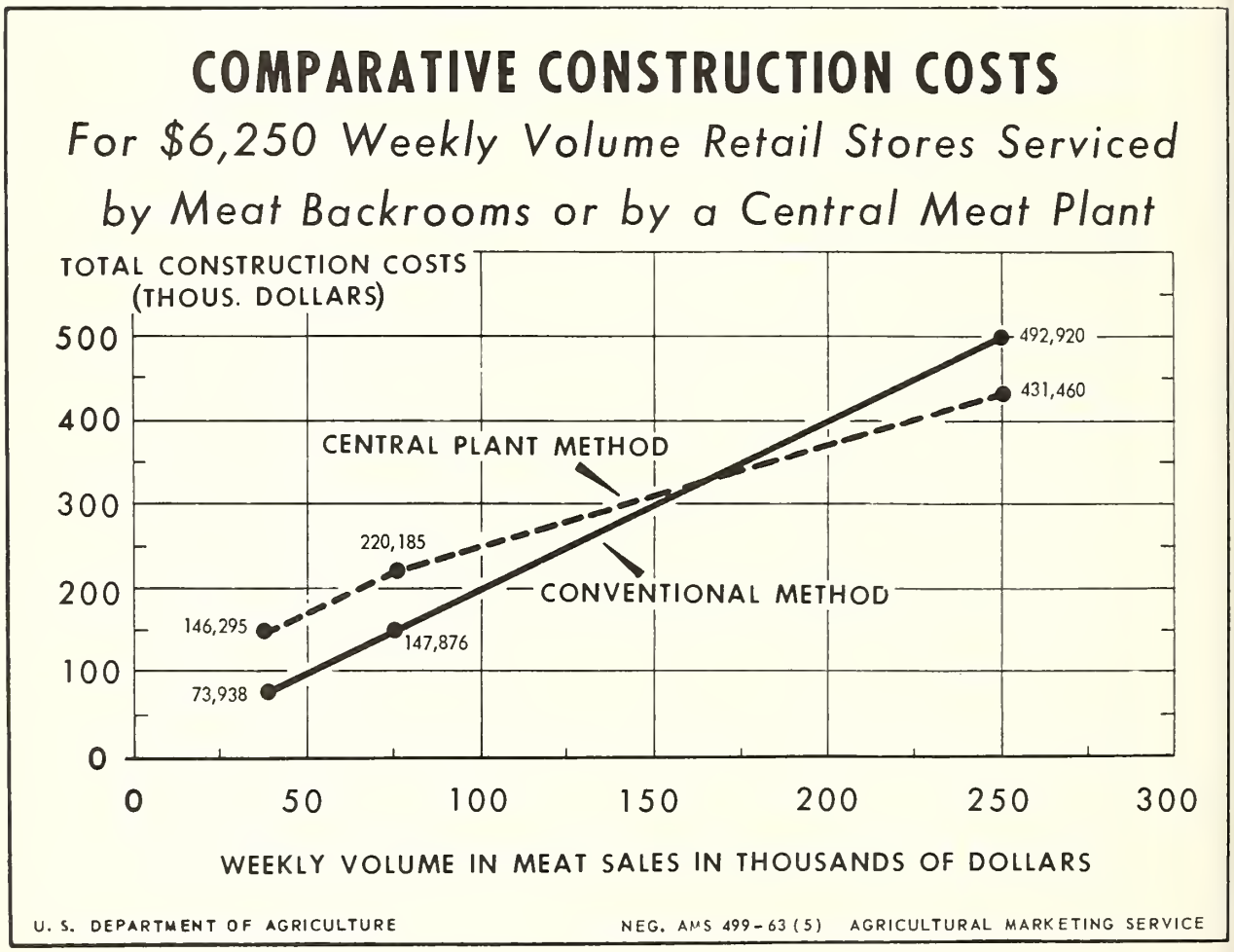


Figure 20.

Equipment Costs

The total cost of equipping central plants is shown in table 1, including the cost of equipment needed at the stores.

Table 1 shows that a central plant designed to handle $75,000 a week in retail meat sales would cost about $73,600 to equip. This includes the amount of equipment needed at the 12 retail stores when the average weekly meat sales are $6,250 per store. The equipment costs would amount to about $137,000 for the 12 stores when the processing was done from efficiently operated individual meat backrooms. A central operation would, therefore, save as much as $64,000 in equipment costs.

A detailed breakdown of equipment requirements and costs for all three volumes of operation can be found on pages 60 through 66 of the appendix.

Table 1.--Equipment costs for meat departments serviced by conventional meat backrooms and by central plants

Stores		Cost of single unit			Total cost		
Weekly volume	Number of units	Conventional store	Store served by central plant	Central plant	Conventional method[1]	Central plant method[2]	Savings using central plant
Dollars	Number	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
$37,500 weekly volume							
3,125	12	[3] 10,903	[3] 2,061	[4] 39,993	130,836	64,725	66,111
6,250	6	[5] 11,420	[5] 2,081	[4] 39,993	68,520	52,479	16,041
$75,000 weekly volume							
3,125	24	[3] 10,903	[3] 2,061	[6] 48,622	261,672	98,086	163,586
6,250	12	[5] 11,420	[5] 2,081	[6] 48,622	137,040	73,594	63,446
$250,000 weekly volume							
6,250	40	[5] 11,420	[5] 2,081	[7] 118,121	456,800	201,361	225,439
10,000	25	[8] 17,691	[8] 2,192	[7] 118,121	442,275	172,921	269,354
16,667	15	[9] 20,260	[9] 2,429	[7] 118,121	303,900	154,556	149,344

[1] Total cost for conventional method is determined by multiplying the cost of a single conventional store times the number of stores involved.

[2] Total cost for central-plant method is determined by multiplying the cost of a single store served by the central plant times the number of stores involved and adding this product to the cost of the equipment in the central plant.

[3] Appendix table 12, p. 63.

[4] Appendix table 9, p. 60.

[5] Appendix table 13, p. 64.

[6] Appendix table 10, p. 61.

[7] Appendix table 11, p. 62.

[8] Appendix table 14, p. 65.

[9] Appendix table 15, p. 66.

Figure 21 is a graphic representation of total equipment cost for either type of operation between weekly volumes of $37,500 and $250,000.

Labor Costs

In a retail store serviced by a central plant, one or two skilled butchers are needed to service the displays and to provide special orders for customer convenience. Efficient work methods and operating procedures were used in this study for conventional and central plant operations in determining the amount of labor required.

Table 2 shows that a central plant with a weekly volume of $75,000 would have an annual labor cost of about $217,000. Included in this figure is the labor force that would be needed in the stores' retail meat departments. The labor costs when processing at the retail stores in the conventional manner would amount to about $373,000 a year. Therefore, a central plant operation of this volume could save as much as $156,000 a year in labor costs. A detailed breakdown of labor costs for both methods of operation at other weekly volume levels appears in the appendix, pages 66 through 68.

The graph in figure 22 represents the total annual labor costs required in either method of operation for weekly volumes ranging from $37,500 to $250,000.

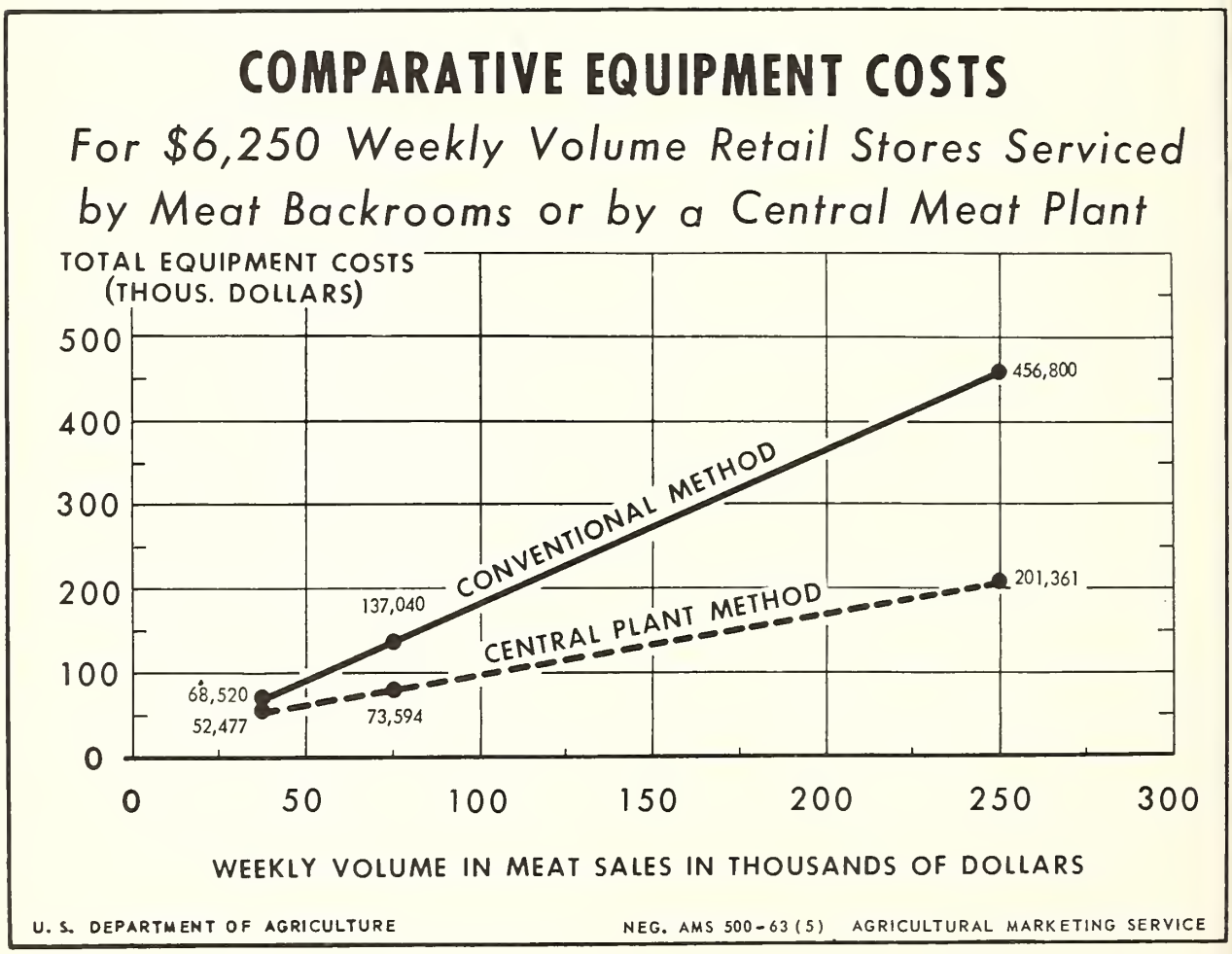


Figure 21.

Table 2.--Labor cost for conventional backroom operation compared to labor cost of a central-plant operation

Stores		Cost of single unit			Total cost		Savings using central plant
Weekly volume	Number of units	Conventional store	Store served by central plant	Central plant	Conventional method[1]	Central plant method[2]	
Dollars	Number	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
$37,500 weekly volume							
3,125	12	[3] 21,057	[4] 9,030	[5] 77,701	252,684	186,069	66,615
6,250	6	[3] 31,090	[4] 9,030	[5] 77,701	186,540	131,885	54,655
$75,000 weekly volume							
3,125	24	[3] 21,057	[6] 9,030	[7] 108,748	505,368	325,484	179,884
6,250	12	[3] 31,090	[7] 9,030	[7] 108,748	373,080	217,116	155,964
$250,000 weekly volume							
6,250	40	[3] 31,090	[8] 9,030	[9] 300,196	1,243,600	661,396	582,204
10,000	25	[3] 46,911	[8] 13,546	[9] 300,196	1,172,775	638,846	533,929
16,667	15	[3] 68,515	[8] 13,546	[9] 300,196	1,027,725	503,386	524,329

[1] Total cost for conventional method is determined by multiplying the cost of a single conventional store times the number of stores involved.

[2] Total cost for central-plant method is determined by multiplying the cost of a single store served by the central plant times the number of stores involved and adding this product to the cost of the labor in the central plant.

[3] Appendix table 22, p. 68.

[4] Appendix table 17, p. 67.

[5] Appendix table 16, p. 66.

[6] Appendix table 19, p. 67.

[7] Appendix table 18, p. 67.

[8] Appendix table 21, p. 68.

[9] Appendix table 20, p. 68.

Combined Construction, Equipment, and Labor Costs

To find the total cost of processing and packaging retail cuts of meat in store backrooms and to compare it to the total cost of processing in a central plant, the construction, equipment, and labor costs must be combined. In this report, the three major costs are calculated on an annual basis, with construction and equipment costs depreciated over a 10- and 5-year period, respectively, using the capital recovery method with a 10-percent interest rate.

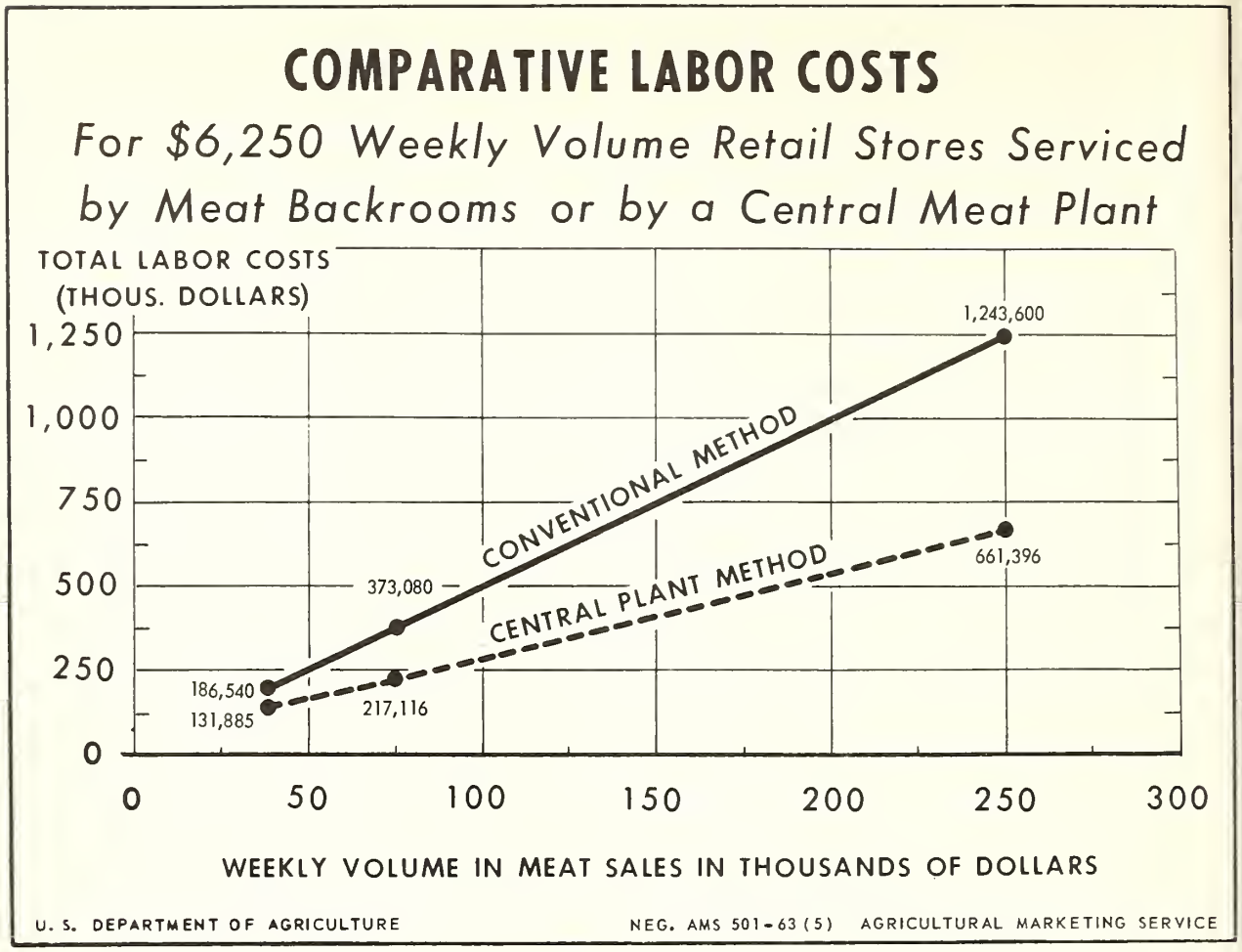


Figure 22.

Calculations for an operation with a $250,000 weekly volume, for both the central-plant and the conventional backroom methods, were made as follows:

I. Construction costs:

	Dollars	
A. Annual depreciated construction cost for a $250,000 weekly volume central plant $241,260 x .16275 (crf)[5]	39,265	
Annual depreciated construction cost for 40 retail stores served by a central plant, each with a weekly volume of $6,250 $190,200 x .16275 (crf)	30,955	
Total annual depreciated construction cost for a $250,000 weekly volume central plant operation plus stores served		70,220
B. Annual depreciated construction cost of backrooms for 40 conventionally operated retail stores with a total weekly volume of $250,000 $492,920 x .16275 (crf)		80,223
C. Annual depreciated savings in construction cost with central-plant method		10,003

[5]Crf is a factor which, when multiplied by the initial investment, will give the uniform annual end-of-year payment necessary to repay the debt in a specified number of years at a given interest rate.

II. Equipment costs:

	Dollars	
A. Annual depreciated equipment cost for a $250,000 weekly volume central plant $118,121 x .26380 (crf)	31,160	
Annual depreciated equipment cost for 40 retail stores served by a central plant each with a weekly volume of $6,250 $83,240 x .26380 (crf)	21,959	
Annual depreciated equipment cost for a $250,000 weekly volume central plant operation plus stores served		53,119
B. Annual depreciated equipment cost of backrooms for 40 conventionally operated retail stores with a total weekly volume of $250,000 $456,800 x .26380 (crf)		120,504
C. Annual depreciated savings in equipment cost with the central-plant method		67,385

III. Labor costs:

A. Annual labor costs for a $250,000 weekly volume central plant	300,196	
Annual labor cost for 40 retail stores served by a central plant, each with a weekly volume of $6,250	361,200	
Total labor costs for central plant plus 40 stores		661,396
B. Annual labor cost of backrooms for 40 conventionally operated retail stores with a total weekly volume of $250,000		1,243,600
C. Annual savings in labor cost with the central-plant method		582,204

IV. Total annual savings in a $250,000 weekly volume central-plant operation compared to conventionally operated retail stores with their own backroom:

Annual depreciated construction savings	10,003
Annual depreciated equipment savings	67,385
Annual labor savings	582,204
Total annual savings	659,592

The graph in figure 23 can be used for estimating the annual savings of a central meat operation compared to conventional meat backrooms for total weekly volumes up to $250,000.

A summary of the overall costs for processing retail cuts of fresh meat for other store volumes appears in table 23 (p. 73). The number of stores serviced by the central plant varies from 6 to 40, depending upon the average volume of the stores involved and the capacity of the central plant itself.

Special Cost Considerations

Central processing of fresh meats appears to offer a number of possibilities for reducing the costs of and promoting the sale of meat products. Many of these possibilities will develop only after the number of plants and their volume increases beyond the

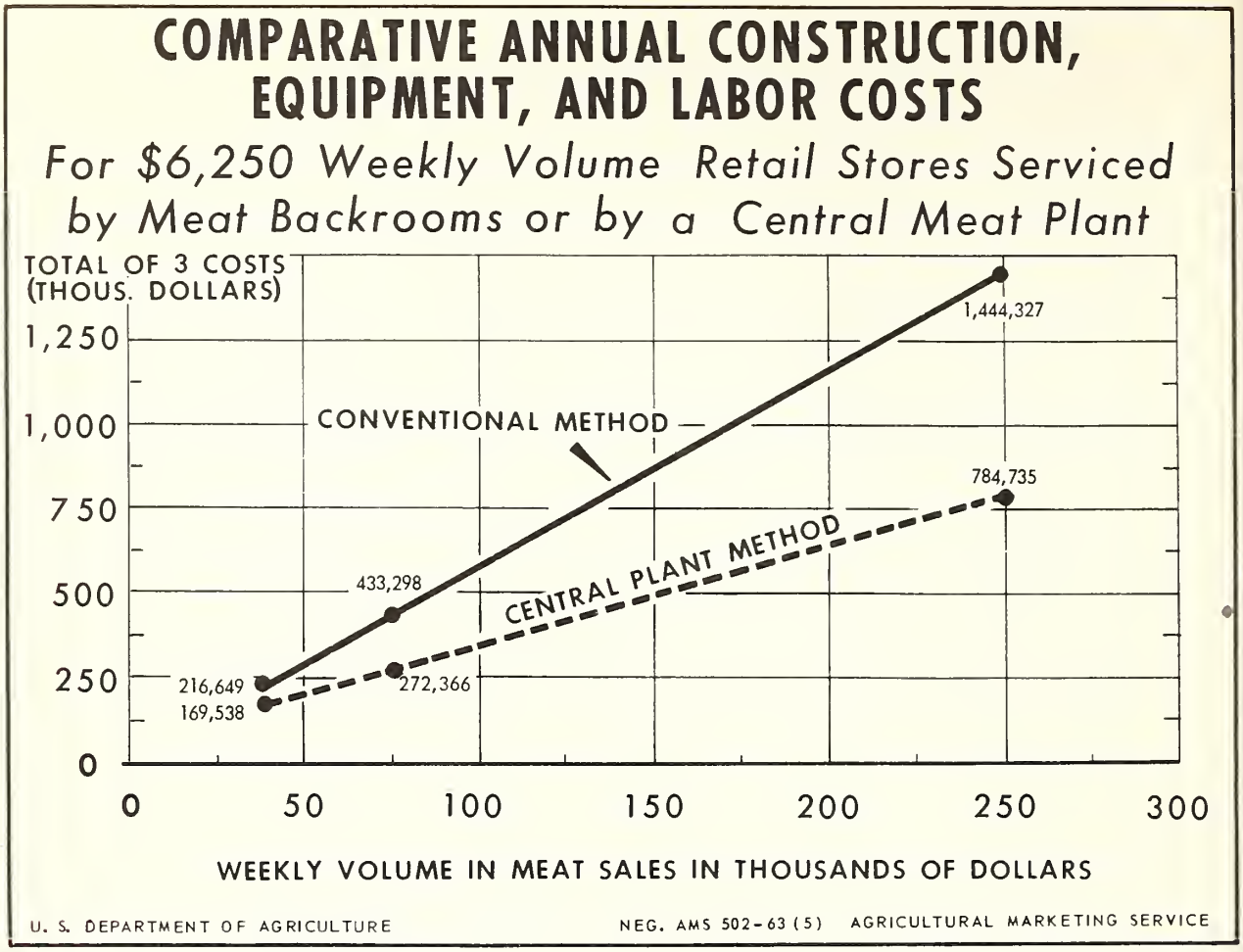


Figure 23.

present levels in the United States. Possible advantages are pointed out here, but no attempt is made to place a monetary value on them:

1. Better discounts from packers and packaging suppliers can often be obtained because deliveries can be fewer and larger. Opportunities exist for bulk handling, using such handling methods as pallet shipment. Individual retailer savings are hard to estimate, because they are reflected in reductions in the price, quality, competition between alternate sources of supply, and lack of knowledge about the suppliers' own delivery costs. Retailers' estimates of savings varied considerably, but ranged from 0.5 to 2 cents per pound for meat carcasses and from 2 to 4 cents per pound on packaged or processed meat products.

2. Another factor affecting costs is the prices obtained for byproducts. Prices received for bones and meat scraps are usually low at the retail store because of the high cost of collecting them. Centralizing the retail meat processing operation makes it possible to collect sizable quantities of scrap and bone which, in some areas, are sold at prices ranging from 1 to 2 cents per pound higher than the price received in retail stores. The average retailer accumulated 12 to 14 percent of carcass weight in these byproducts. A central plant processing for $75,000 of retail meat sales per week might save from $4,000 to $5,000 per year on this factor, based on the price differential mentioned.

3. A detailed comparison of the delivery cost for central plants and delivery cost for conventional retail stores will be dealt with in another report. In this report, delivery cost will be considered to be approximately the same for both methods. However, the need for daily deliveries from a central meat plant to retail stores could possibly be higher than the delivery cost presently incurred in shipping carcass meat from a central warehouse.

4. Central processing permits distribution of meat cuts according to market preference. For years, retailers have been attempting to devise means of providing better distribution of retail cuts. Central meat processing, with this type of distribution, might improve total dollar yield from a carcass when all cuts were shipped to the stores according to consumer demand.

5. Central processing provides more uniform cutting. Cutting done in one location is easier to control and provides greater standardization in cuts. This should also provide opportunities to improve carcass yield and eliminate waste.

6. Central control of ordering and inventories can provide means of controlling overhead costs and maximizing sales.

7. Methods of cutting and types of cuts offered for sale can be controlled more readily. Meat can be cut in a special way for a promotion or to fill a particular need. Costs of individual cuts are better known, which should permit more realistic pricing.

8. Meat packages delivered from the central plant are ready for sale as soon as they arrive at the store. Such deliveries, when properly done, can eliminate much of the out-of-stock conditions often found in meat cases, and give the customer a larger selection of cuts to choose from.

PRODUCTION PLANNING AND CONTROL

The purpose of a production planning and control system is to give the central plant manager an accurate method for determining the amount of production needed during any given period. Shortages and overages can be held to a minimum, the workload of the crew kept in better balance, and efficient scheduling of deliveries to the stores facilitated.

For effective production control, all the planning and control work should be done by specialists on a supervisory level and should not be the responsibility of the operational personnel. Some of the specific objectives of this function are: (7)

1. Inventory methods that are adequate, but simple.

2. Centralized planning.

3. Maintenance of uniform workloads.

4. Information that will enable the plant manager to anticipate difficulties.

5. Accurate current information regarding the progress of all orders, and provision for corrective action with respect to delays.

6. Advance provision for material and packaging supplies to prevent delays and idle time.

7. Accumulation of information that will improve the accuracy of future planning and reduce the work involved.

The production planning and control function in a central plant represents a specialized area of administrative activity. The plant manager should have administrative ability as well as operational knowledge. In setting up a production control system, all conditions and situations should be covered without an undue number of "special" forms or other improvised procedures (7).

In a central meat-packaging plant, the flow control method of production is probably the best. The control points in a central plant are the specific processing centers, such as cutting, wrapping, and pricing. A given amount of work is scheduled for each of these centers in a given period of time. The planning function consists primarily of establishing hourly, daily, weekly, and monthly production quantities. The main job of plant supervision then becomes one of control, to see that schedules are kept.

Design and Use of Forms

To obtain reasonable accuracy in estimating the amount to produce, each individual store order should be based on daily store inventories, past sales, and any other special considerations which may affect sales. An efficient inventory control system is a basic requisite for the successful operation of a central meat plant. It is imperative that the central plant be able to supply each store with the required amount and quality of the desired items.

The design and type of forms used in the inventory control system vary according to volume, the number of stores serviced, and, to some extent, company preference. In most cases, two types of forms are needed in a central-plant operation to aid in determining the amount to produce. One form is designed for obtaining data on each store, while the second form is designed for production information needed for the efficient operation of the central plant.

Form "A," called "Meat Prepack Inventory and Order Sheet," should contain columns for the following information:

1. Inventory.
2. Number of packages ordered.
3. Number of packages shipped out.
4. Number of damaged packages "pulled" from the display case.
5. Number of packages actually on display at the store after returns have been deducted.
6. Number of packages sold.

Form "B" can be titled "Daily Production Form," and should contain columns for the following information:

1. Primal cuts.
2. Inventory of selection cooler.
3. Amount ordered for each store.
4. Total amount of each item ordered for the stores.
5. Amount to produce.

As the volume and the number of stores serviced become greater, it may be more feasible to process the information with data processing equipment, but the same basic information would still be needed.

The two forms shown in this report were developed by AMS researchers for a central fresh meat packaging plant in the eastern section of the country. They are used in this report as an illustration of the production planning and control system. The central plant using these forms in the manner described in this report is servicing three stores located within a 3-mile radius. The stores are doing a total meat retail volume of $10,000 to $15,000 per week.

The design of form A, Meat Prepack Inventory and Order Sheet, is shown in figure 24. Each store phones in its daily inventory of individual meat packages, and the person handling the records at the plant fills in the inventory column. These records may be kept by the central plant manager or his assistant, in a small plant, or by a production control department or accounting office in a larger operation. The "Package Order" column is filled out by the production control department, using daily sales records of the past movement of each individual store.

The assembling of Thursday's inventory and order sheets for 4 weeks is shown in figure 25. Records are kept, for each day of the week on all stores, by the production control department. Upon completion, each week's Thursday inventory and order form is positioned under the previous Thursday's, allowing only the "Number Sold" column to show. The oldest Thursday is removed to maintain the 4-week record.

As illustrated in figure 26, the record of sales for the past 4 weeks for a given day of the week, in this case Thursday, is used to prepare the individual store order. The new inventory and order form, with only the inventory column filled in, is positioned under that store's records of past 4 weeks of sales for that particular day. The amount of an item to order for a store is determined by using the last 4 weeks of sales as an indicator of sales, and then allowing for the amount in inventory plus or minus an additional amount to adjust for special considerations. The number of items to ship is placed in the store's packaged order column.

MEAT PREPACK INVENTORY AND ORDER SHEET

Store #1 (Form A) Day - Thurs. Date 6/20

Item	Inv.	Pkg. ord.	Shipped	Ret.	On hand	No. sold
BEEF	XXXXXXXX	XXXXXXXX	XXXXXXXXXXXXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXXX
Tenderloin steak	2	9	5-4	1	10	5
Rump steak, sh. cut	0	4	4	0	4	3
N.Y. sirloin stk.	1	10	5-5	1	10	9
Thin sh. cut steak	0	3	3	0	3	3
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXXXXXXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXXX
Porterhouse stk. D.P.	0	6	3-3	0	6	5
Porterhouse steak	2	18	8-10	1	19	15
T-bone steak	1	10	4-6	0	11	8

Figure 24.--A meat prepack inventory and order form for a retail store served by a central plant.

MEAT PREPACK INVENTORY AND ORDER SHEET Store #1 (Form A)					Day: Thurs. Date: 6/20		Thurs. 6/27	Thurs. 7/4	Thurs. 7/11
Item	Inv.	Pkg. ord.	Shipped	Ret.	On hand	No. sold	No. sold	No. sold	No. sold
BEEF	XXXX	XXXXX	XXXXXXXXX	XXXXX	XXXXX	XXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXX
Tenderloin steak	2	9	5-4	1	10	5	8	7	8
Rump steak, sh. cut	0	4	4	0	4	3	6	3	4
N.Y. sirloin stk.	1	10	5-5	1	10	9	9	4	8
Thin sh. cut steak	0	3	3	0	3	3	8	3	9
XXXXXXXXXXXXXXXXXXXXXXX	XXXXX	XXXXX	XXXXXXXXX	XXXXX	XXXXX	XXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXX
Porterhouse stk. D.P.	0	6	3-3	0	6	5	3	4	3
Porterhouse steak	2	18	8-10	1	19	15	12	14	12
T-bone steak	1	10	4-6	0	11	8	9	3	9

Figure 25.--Assembling a store's inventory and order sheets in a manner that aids in predicting sales.

At the end of each week, all individual-store daily inventory and order forms that are 5 weeks old are secured together so that each day's "Number Sold" column is exposed. These are placed in a permanent ledger, and individual item sales are totaled for the week for each store and for the total company sales of all stores (fig. 27).

At the same time, information on "specials," weather, and other factors that may affect sales is entered in the ledger. These records have been extremely useful in predicting sales under special or unusual conditions.

After all the stores' orders are calculated and entered in the "Package order" column on their respective inventory and order forms, the next step is to work up the total production needed to supply all the stores to be serviced. This particular daily production form (form B), shown in figure 28, was specifically designed for a central plant supplying three stores.

All the stores' daily orders are posted on this form under their respective columns. The total of each item ordered for all the stores is calculated, and this figure is entered in the "Total ordered" column. The last column on the form is titled "Amount to produce" and is used by the production control manager to vary the order, taking into account the day of the week, the number of primal cuts needed to fill the orders, and whether the sales of an item has been increasing or decreasing. This final production estimate is placed in the "Amount to produce" column and is the actual amount the central plant will produce.

MEAT PREPACK INVENTORY AND ORDER SHEET

Store #1 (Form A) Day: Thurs. Date: 6/20

Item	Inv.	Pkg. ord.	Shipped	Ret.	On hand	No. sold	Thurs. 6/27 No. sold	Thurs. 7/4 No. sold	Thurs. 7/11 No. sold
BEEF	XXXX	XXXX	XXXXXXXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
Tenderloin steak	2	9	5-4	1	10	5	8	7	8
Rump steak, short cut	0	4	4	0	4	3	6	3	4
New York sirloin steak	1	10	5-5	1	10	9	9	4	8
Thin short cut steak	0	3	3	0	3	3	8	3	9
XXXXXXXXXXXXXXXXXX	XXXX	XXXX	XXXXXXXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
Porterhouse steak, D.P.	0	6	3-3	0	6	5	3	4	3
Porterhouse steak	2	18	8-10	1	19	15	12	14	12
T-bone steak	1	10	4-6	0	11	8	9	3	9

INVENTORY AND ORDER SHEET

(Form A) Day: Thurs. Date: 7/18

Item	Inv.	Pkg. ord.	Shipped	Ret.	On hand	No. sold
BEEF	XXXX	XXXX	XXXXXXXXX	XXXX	XXXX	XXXX
Tenderloin steak	2	10				
Rump steak, short cut	0	5				
New York sirloin steak	4	7				
Thin short cut steak	1	10				
XXXXXXXXXXXXXXXXXX	XXXX	XXXX	XXXXXXXXX	XXXX	XXXX	XXXX
Porterhouse steak, D.P.	0	6				
Porterhouse steak	3	12				
T-bone steak	2	9				

Figure 26.--Assembly of forms to assist the production control manager in making up a store's order.

MEAT PREPACK INVENTORY AND ORDER SHEET (Form "A") Store #1					Day: Date:	Mon. 6/10	Tues. 6/11	Wed. 6/12	Thurs. 6/13	Fri. 6/14	Sat. 6/15	Weekly sales ledger for all stores: Store #1	Store #2
Item	Inv.	Pkg. ord.	Shipped	Ret.	On hand	No. sold	No. sold	No. sold	No. sold	No. sold	No. sold	No. sold	No. sold
BEEF	XXXXXX	XXXXXX	XXXXXX	XXXXXX	XXXXXX	XXXXXX	XXXXXX	XXXXXX	XXXXXX	XXXXXX	XXXXXX		
Tenderloin steak	3	9	6-3	2	10	5	3	5	7	9	7	36	-
Rump steak, sh. cut	0	5	5	0	5	3	2	3	4	7	8	27	-
N.Y. sirloin stk.	2	10	5-5	1	11	5	3	4	9	13	11	45	-
Thin sh. cut steak	1	3	3	0	4	4	6	5	8	10	8	41	-
XXXXXX	XXXXXX	XXXXXX	XXXXXX	XXXXXX	XXXXXX	XXXXXX	XXXXXX	XXXXXX	XXXXXX	XXXXXX	XXXXXX	XXXXXX	
Porterhouse stk. D.P.	1	5	5	1	5	2	0	4	3	4	4	17	-
Porterhouse steak	3	15	10-5	1	17	5	6	8	11	13	11	54	-
T-bone steak	2	10	5-5	2	10	5	3	4	8	10	9	39	-

Figure 27.--Assembling the forms to facilitate calculating the weekly sales.

DAILY PRODUCTION SHEET--MEAT DEPARTMENT

Day Thursday (Form B) Date 7/18/60

Item		Prim.	Inv. coolr.	Packgs. ordered			Total ordered	Amount to produce
				Store #1	Store #2	Store #3		
BEEF	XXXXX	XXXXXXX	XXXXXXX	XXXXXX	XXXXX	XXXXX	XXXXXXXXXX	XXXXXXXXXXXXX
Tenderloin steak			0	13	7	9	29	36
Rump steak, short cut			2	5	4	5	12	20
N.Y. sirloin steak			4	10	8	9	23	30
Thin short cut steak			3	9	4	5	15	22
XXXXXXXXXXXXXXXXXXXXXXXXX	XXXXX	XXXXXXX	XXXXXXX	XXXXXX	XXXXX	XXXXX	XXXXXXXXXX	XXXXXXXXXXXXX
Porterhouse steak D.P.			2	3	2	33	6	8
Porterhouse steak			5	12	8	77	22	30
T-bone steak			6	9	5	8	16	22
Club steak			4	5	13	3	17	17

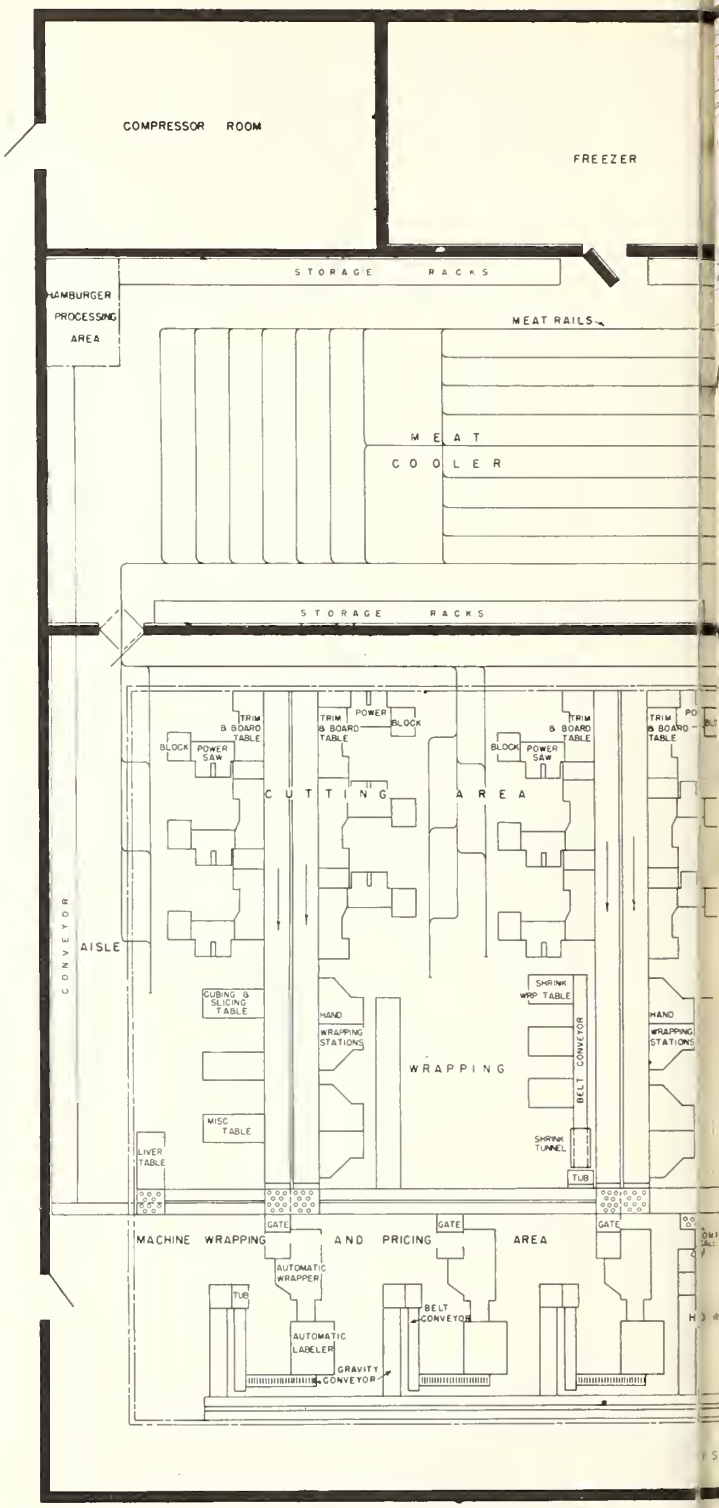
Figure 28.--Design of form to be used at a central plant in consolidating all store orders to arrive at total daily production needed.

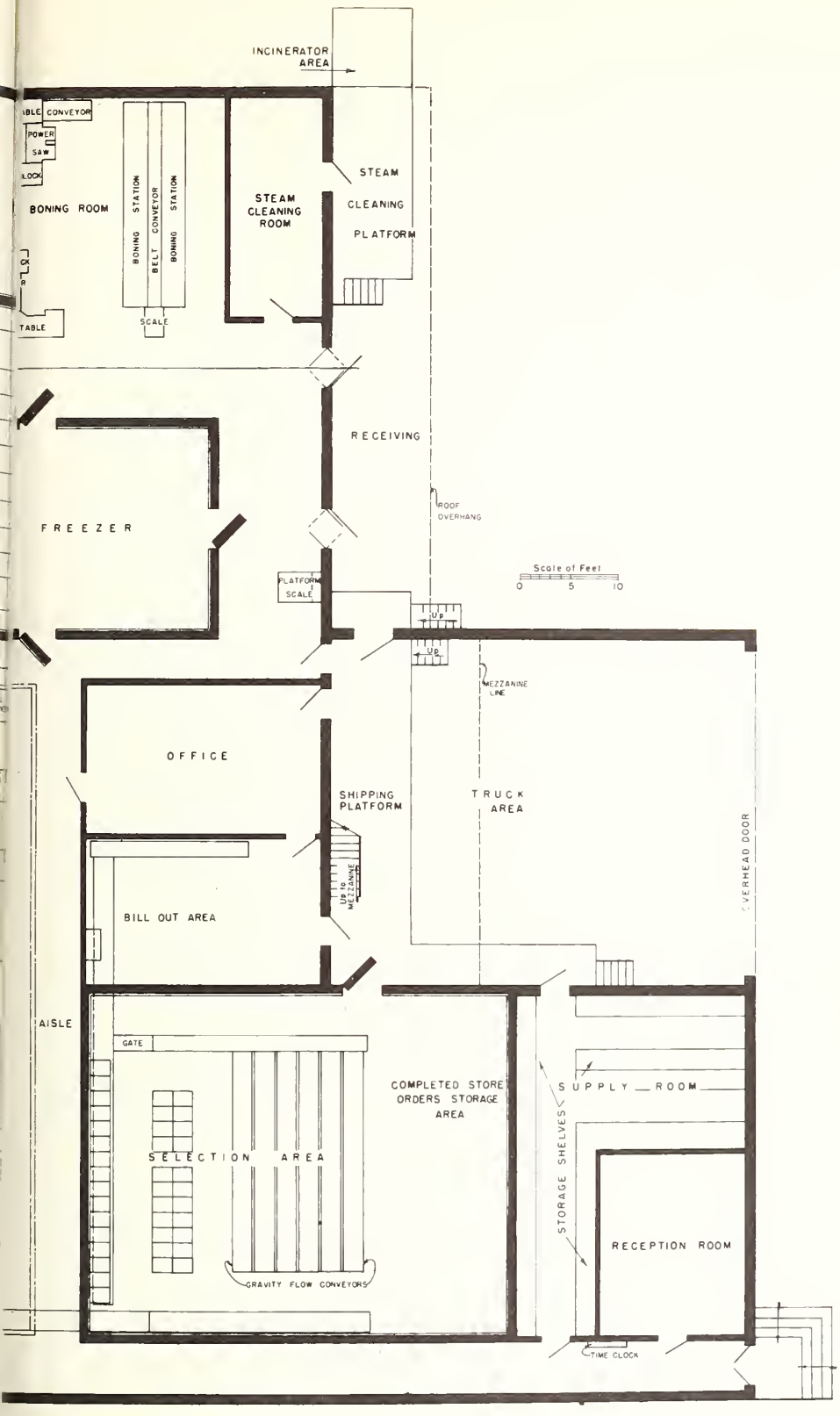
After the daily production form is completed, it is posted on the cutters' production board. When the cutters report to work, they check the production board for the amount of each item that they will be responsible for.

Labor and Equipment Scheduling

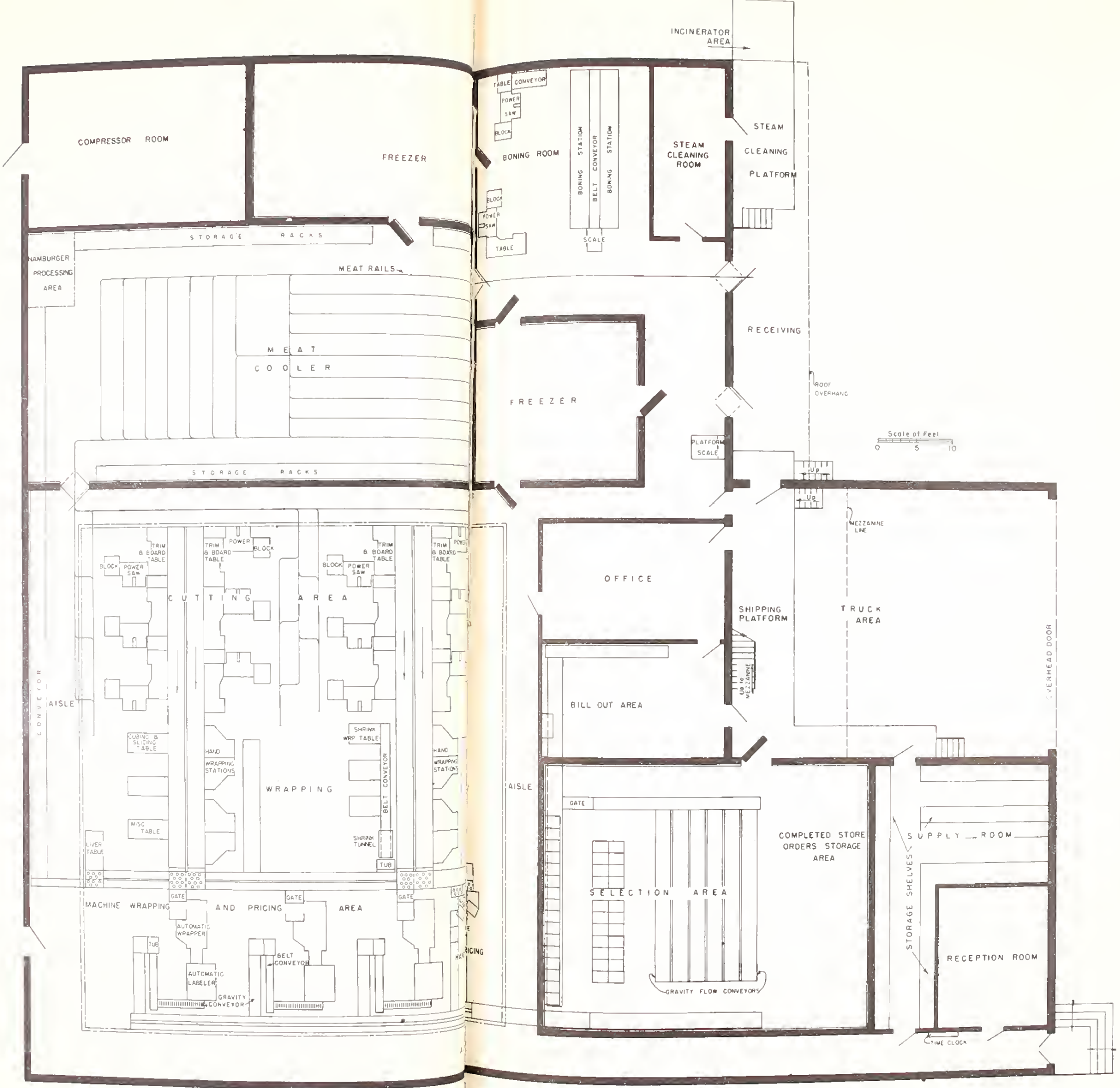
The second phase of a good production control system is the establishment of an effective scheduling system. Scheduling determines when each item or operation must be performed to insure that the product will be in the store display cases at the time it is needed.

The first step in setting up a scheduling system is to determine the processing time for each of the products produced by the central plant. The production times used for processing retail meat cuts at a central plant were derived from time standards established for the same operations as performed at the store level in efficiently operated meat backrooms. Because of the production-line layout of the central plant, certain irregular elements have been eliminated in the calculation of the derived processing times. When more accurate processing times are available, they should be substituted for these derived times for a tighter and more efficient scheduling system.


COMPRESSOR ROOM
FREEZER
STORAGE RACKS
HAMBURGER PROCESSING AREA
MEAT RAILS
MEAT COOLER
STORAGE RACKS
CONVEYOR
AISLE
TRIM & BOARD TABLE
BLOCK
POWER SAW
POWER BLOCK
CUTTING AREA
CUBING & SLICING TABLE
HAND WRAPPING STATIONS
WRAPPING
BELT CONVEYOR
SHRINK WRP TABLE
SHRINK TUNNEL
MISC TABLE
LIVER TABLE
TUB
GATE
MACHINE WRAPPING AND PRICING AREA
AUTOMATIC WRAPPER
AUTOMATIC LABELER
BELT CONVEYOR
GRAVITY CONVEYOR



e-volume central meat plant.



large-volume central meat plant.

First, it must be decided what type of equipment should be used for the various processing operations. Table 3 shows the time it takes to process the product with several different types of equipment, using derived times and a given product mix. The anticipated total volume of the central plant in this example amounts to $100,000 a week.

The next decision to be made concerns the total amount and types of processing equipment needed to complete the work in the allotted time. Table 4 is a starting point from which to work; by itself, it will not necessarily give the final answer as to the actual amount of equipment that will eventually be used in the central plant. For this example, it was assumed that the volume of the plant was large enough to warrant the use of the fastest type of production equipment available. For instance, table 4 shows that it would require 80.8 man-hours to cut and tray the meat, using an efficient cutting and traying station. The minimum number of work stations needed is calculated for a 40-hour week, allowing a 1-hour lunch break in an 8-hour shift. Since there are 7 hours of production time during a shift, a total of 11.5 cutting and traying stations are required to handle the total production. Therefore, at least 12 cutting and traying stations will be needed in a $100,000 plant, the exact number depending on how efficiently work can be scheduled at the various processing stations.

A method or plan is then developed which will determine what operations are to be done on the product, their sequence, the type and number of work stations and equipment needed, and the time at which these operations will be performed. Variations of the Gantt chart[6] as shown in figures 29, 30, 31, 32, and 33 can be used to aid in the solution of these problems.[7] This type of chart mainly emphasizes that time is the most important element in production (6) (7).

The bar chart shown in figure 29 was constructed to show in sequence all the processing operations that occur on all major items packaged at a central plant with $100,000 weekly volume. Each operation is plotted against length of time it takes to process the different retail cuts. The operational times are taken from table 4 of this report. The first two processing operations shown in figure 29 are used to explain the chart. The S-1 operation of cutting and traying steaks consumes an estimated 20.6 hours of processing time at an efficient cutting station. The S-2 operation of wrapping and pricing steaks on an automatic wrapper equipped with an auto-labeler requires 5.9 hours. Because the cutting and traying operation is longer, the wrapping and pricing operation should be scheduled, as shown in figure 29, to start 5.9 hours before the end of the cutting and traying operation, in order to attain maximum utilization of the production capacity of the automatic wrapper.

If the second operation is longer than the first, as in the case of the R-2 operation of hand-wrapping roasts, then the second operation can be started at the same time as the preceding operation.

After the bar chart shown in figure 29 has been constructed, the next step is to schedule the total processing time of all the operational functions within a working day. In this example, the work has been scheduled to an 8-hour shift, but other shift variations could be used, depending upon the circumstances.

As shown in figure 29, the S-1 operation of cutting and traying steaks requires a total processing time of 20.6 hours. Therefore, completion of the total processing in the S-1 operation, within the 7 hours of actual production time available, requires that the work be scheduled to three work stations, as illustrated in figure 30. The S-2 operation can be satisfactorily handled by one automatic wrapping machine and automatic labeler, since the function of wrapping and pricing with this equipment requires 5.9 hours. The S-2 operation should be scheduled to start 5.9 hours before the end of the S-1 operation, for maximum utilization of the production capacity of this equipment. All the other processing operations are scheduled similarly.

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[6] A method developed by Henry L. Gantt for plotting plans on progress of operations in relation to time.

[7] Gantt chart vertical axis lists the jobs to be done, horizontal axis represents time to do the work.

Table 3.--Production time for processing at a central meat prepackaging plant with a weekly volume of $100,000 in fresh red meats

Item	Pkgs. per week[1]	Maximum pkgs. per day[2]	Cutting and traying time per unit[3]	Total cutting and traying time	Wrapping and/or pricing time per unit	Total wrapping and/or pricing time	Type of equipment
	Number	Number	Minutes	Hours	Minutes	Hours	
Steaks	24,226	6,541	.189	20.6	.108	11.8	Semiautomatic wrapper and automatic scale and labeler
					.054	5.9	Automatic wrapper and automatic scale and labeler
Roasts	5,638	3,099	.217	11.2	.385	19.9	Hand-wrap stations
					.108	5.6	Conventional scale
Ground meat	10,881	3,409	.152	8.6	.054	3.1	Automatic wrapper and automatic scale and labeler
Misc. beef	3,518	799	[4] .511	6.8	.054	1.0	Automatic wrapper and automatic scale and labeler
					.108	1.9	Semiautomatic wrapper and automatic scale and labeler
Pork	7,918	2,423	.172	6.9	.054	2.2	Automatic wrapper and automatic scale and labeler
					.108	4.4	Semiautomatic wrapper and automatic scale labeler
Lamb legs	258	113	.246	.5	.534	1.0	Hand-wrap stations
Lamb	518	225	.131	.5	.054	.20	Automatic wrapper and automatic scale labeler
					.108	.4	Semiautomatic wrapper and automatic scale labeler
Poultry	22,500	4207 W	.147	10.3	.108	7.6	Hand-wrap stations
		4208 C	.220	15.4	.054	3.8	Automatic wrapper and automatic scale labeler
Ham	7,889	2,422	.213	8.6	.444	18.3	Hand-wrap stations
					.108	4.4	Conventional scale

[1] Based on production of $100,000 in fresh red meats.
[2] Estimated maximum daily production.
[3] Cutting times based on standards taken from MRR No. 41 and supporting data.
[4] Estimated cutting and traying times.

Table 4.--Hours of operating time at each station required for equipment in a $100,000-a-week central fresh meat processing plant

Processing operation and work station numbers	Cutting and traying station	Ground meat and traying station	Automatic wrapping and pricing station	Hand wrapping station	Shrink tunnel	Conventional automatic weighing and pricing station
	Hours	Hours	Hours	Hours	Hours	Hours
S--1	20.6					
S--2			5.9			
R--1	11.2					
R--2				19.9		
R--3						5.6
GM-1		8.6				
GM-2			3.1			
MB-1	6.8					
MB-2			1.0			
P--1	6.9					
P--2			2.2			
LL-1	.5					
LL-2				1.0		
LL-3						.2
LC-1	.5					
LC-2			.6			
PW-1	10.3					
PW-2						7.6
PC-1	15.4					
PC-2			3.8			
H--1	8.6					
H--2					18.3	
H--3						4.4
Total hours	80.8	8.6	16.6	22.4	18.3	22.8
Decimal station req.	11.54	1.23	2.37	3.20	2.61	3.25
Actual no. stations req.	12	2	3	4	3	3

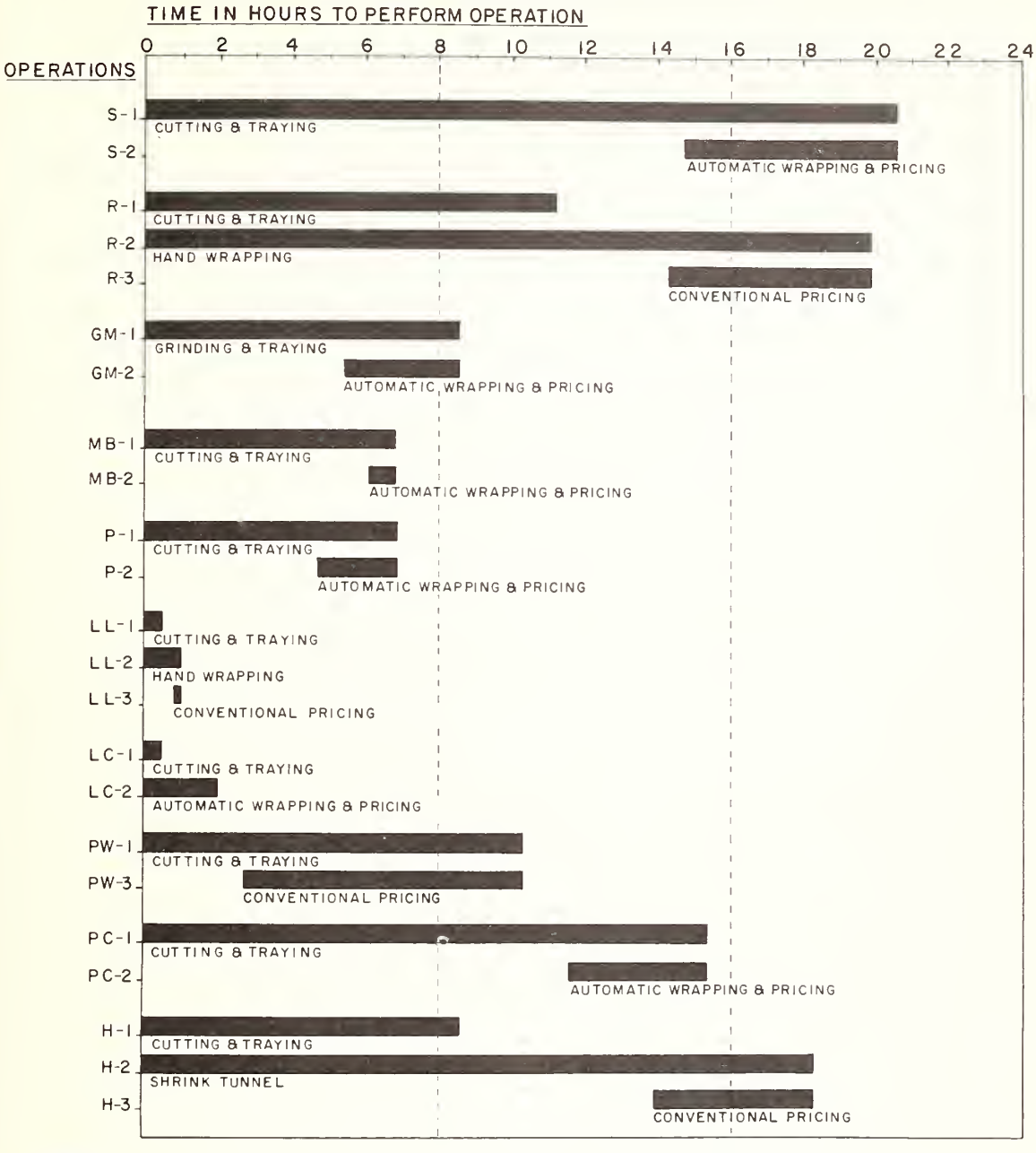
LEGEND

S--Steak
R--Roast
GM--Ground meat
MB--Miscellaneous beef
P--Pork
LL--Leg of lamb
LC--Lamb chops
PW--Poultry (whole)
PC--Poultry (cut up)
H--Ham

Operations

1--Cutting, traying, grinding, or bagging
2--Automatic wrapping and pricing or hand wrapping
3--Conventional pricing

PROCESSING TIME AND SEQUENTIAL SCHEDULING OF OPERATIONS PERFORMED ON EACH MAJOR MEAT CATEGORY IN A $100,000 WEEKLY VOLUME CENTRAL MEAT PLANT 1/



LEGEND

S--Steak GM--Ground Meat P--Pork LC--Lamb Chops PC--Poultry (cut-up)
R--Roast MB--Miscellaneous Beef LL-Leg of Lamb PW-Poultry(whole) H---Ham

OPERATIONS

1--Cutting, Traying, Grinding or Bagging 2--Automatic Wrapping & Pricing or Hand Wrapping
3--Conventional Pricing

1/ DAY OF MAXIMUM PRODUCTION

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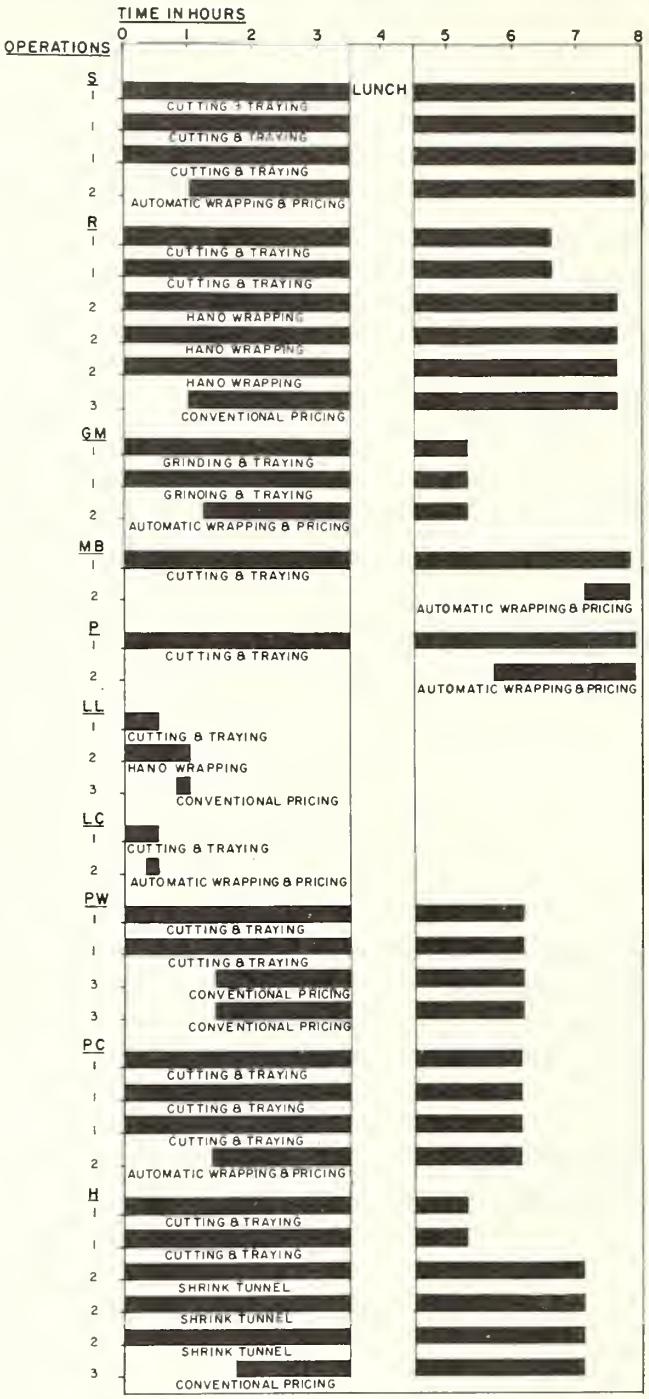
Figure 29.

PROCESSING TIME AND SEQUENTIAL SCHEDULING OF OPERATIONS PERFORMED ON EACH MAJOR MEAT CATEGORY IN A $100,000 WEEKLY VOLUME CENTRAL MEAT PLANT WITHIN AN 8-HOUR SHIFT 1/



LEGEND

S--Steak GM--Ground Meat P--Pork LC--Lomb Chops PC--Poultry(cut-up)
R--Roast MB--Miscellaneous Beef LL-Leg of Lomb PW -Poultry(whole) H - -Ham

OPERATIONS

1--Cutting, Troying, Grinding or Bagging 2--Automotic Wrapping & Pricing or Hond Wrapping
3-Conventionol Pricing

1/ DAY OF MAXIMUM PRODUCTION - 7 HOUR WORKING DAY

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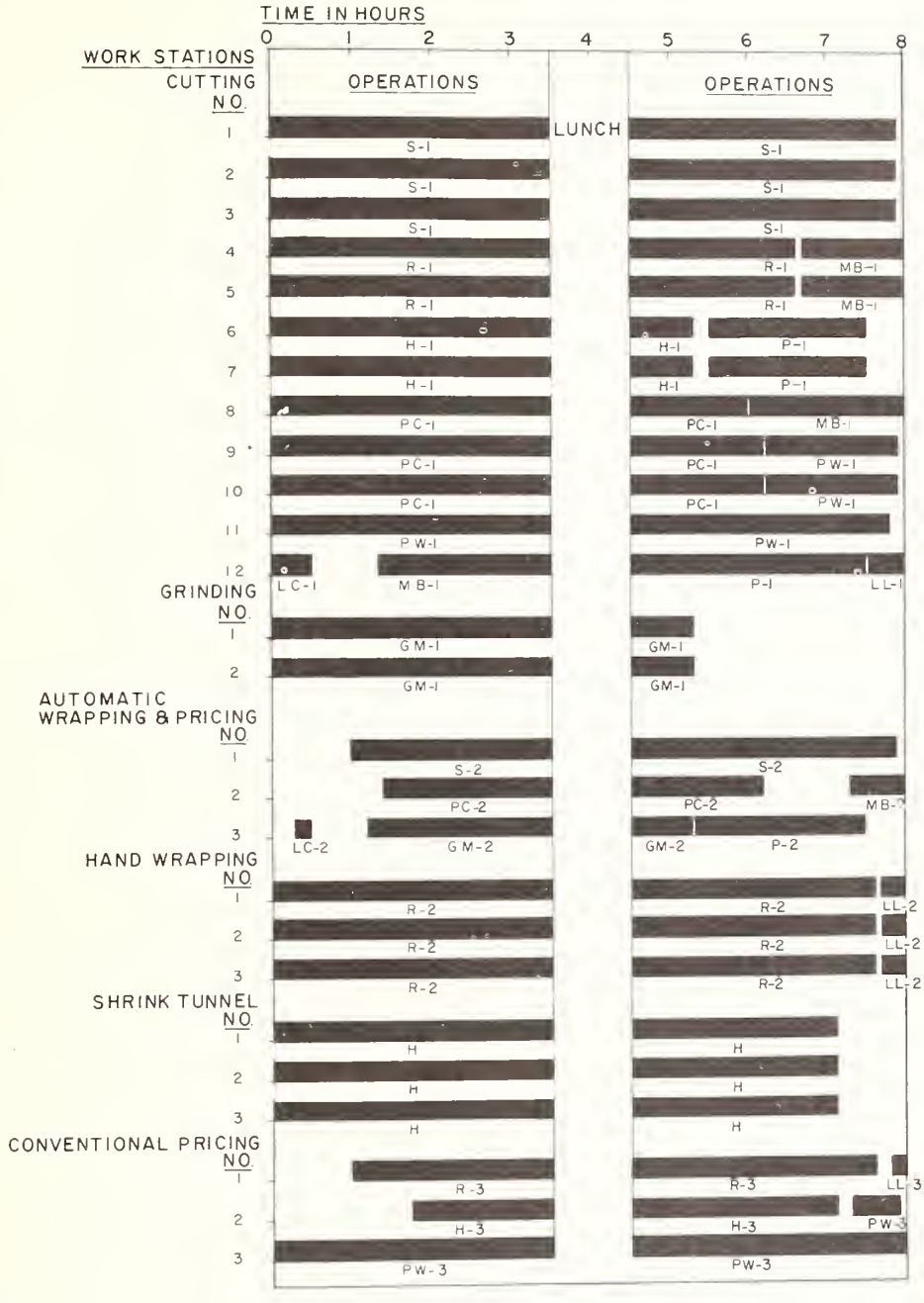
Figure 30.

PROCESSING TIME OF OPERATIONS PERFORMED ON EACH MAJOR MEAT CATEGORY SCHEDULED AT SPECIFIC WORK STATIONS IN A $100,000 WEEKLY VOLUME CENTRAL MEAT PLANT BASED ON ONE DAILY SET-UP 1/



LEGEND

S--Steak GM--Ground Meat P--Pork LC--Lamb Chops PC--Poultry (cut-up)
R--Roast MB--Miscellaneous Beef LL--Leg of Lamb PW--Poultry (whole) H--Ham

OPERATIONS

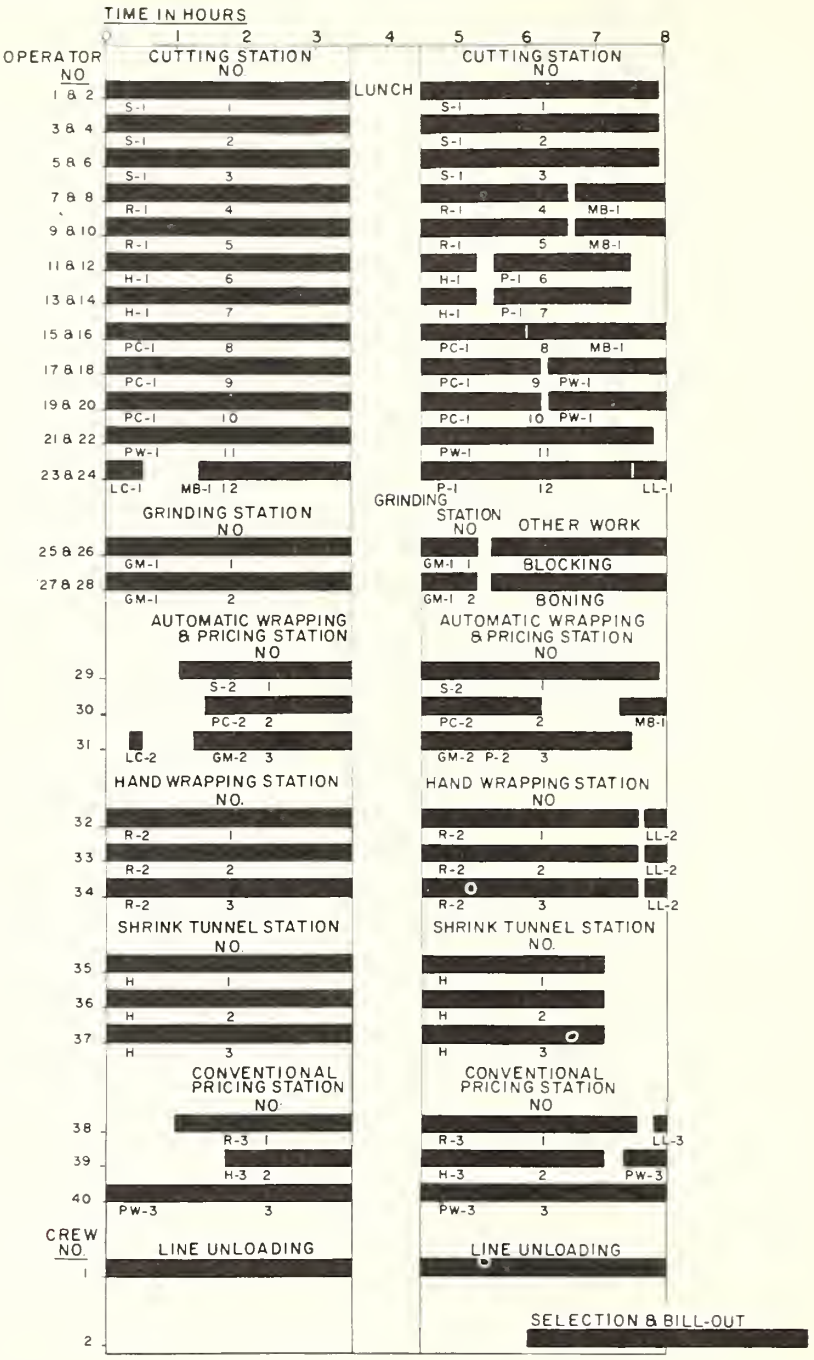
1--Cutting, Traying, Grinding or Bagging 2--Automotic Wrapping & Pricing or Hand Wrapping
3--Conventional Pricing

1/ DAY OF MAXIMUM PRODUCTION

US DEPARTMENT OF AGRICULTURE NEG. AMS 337-63 (4) AGRICULTURAL MARKETING SERVICE

Figure 31.

LABOR SCHEDULED AT SPECIFIC WORK STATIONS IN A $100,000 WEEKLY VOLUME CENTRAL MEAT PLANT BASED ON ONE DAILY SET-UP 1/



LEGEND

S--Steak GM--Ground Meat P--Pork LC--Lamb Chops PC--Poultry (cut-up)
R--Roast MB--Miscellaneous Beef LL-Leg of Lamb PW-Poultry (whole) H--Ham

OPERATIONS

1--Cutting, Traying, Grinding or Bagging 2--Automatic Wrapping & Pricing or Hand Wrapping
3--Conventional Pricing

1/ DAY OF MAXIMUM PRODUCTION

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Figure 32.

The next phase of scheduling is to allot the processing times of all the operations in a central meat plant to a number of specific work stations. This should allow production to be completed within a normal 8-hour shift with maximum loading of work stations and equipment. It is necessary to use table 4 and figure 30 when constructing the chart shown in figure 31.

As shown in figure 31, the S-1 operation on steaks is scheduled to be done on cutting stations Nos. 1, 2, and 3, utilizing them for 6.9 hours of the 7 hours of actual production time available. It is unlikely that other items can be scheduled at these cutting stations, because they are being used to near capacity.

For example, roasts are scheduled on cutting stations Nos. 4 and 5, loading each of them for 5.6 hours or a total processing time for the R-1 operation of 11.2 hours. Cutting stations Nos. 4 and 5 will therefore be idle for 1.4 hours unless more work is scheduled at these two work stations. To load stations 4 and 5 to capacity, part of the MB-1 production has been scheduled to them. As the chart is further developed, it will be possible to schedule the remaining production of the MB-1 operation to cutting station No. 8, thereby loading this work station to capacity.

It will not always be possible to load all work stations and equipment to their capacities. There will be times when no work is being done on a particular work station or piece of equipment, but a loading chart as shown in figure 31 is an extremely useful device in obtaining maximum possible utilization of equipment and labor. The chart aids in balancing production between various work stations, besides determining the actual amount of equipment and work stations needed to produce a given volume within an 8-hour shift.

In constructing a loading chart of this type, the various operations must be placed at several different work stations before the best combination can be developed.

A chart similar to the one shown in figure 31 can now be constructed for the purpose of assigning operators to specific work stations and jobs. For example, figure 32 shows that operators Nos. 7 and 8 are scheduled to work at cutting station No. 4 and will be cutting roasts for the first 5.6 hours of the shift. During the last part of the shift, they will be cutting and traying miscellaneous beef for 1.3 hours. Loading cutting station No. 4 in this manner utilizes it for 6.9 hours of the 7 production hours available. The same technique is used in scheduling labor to the remaining equipment and jobs.

Delivery Scheduling

Setting up an efficient delivery operation is another important function in a central fresh meat operation, since the deliveries affect the entire scheduling system. For instance, if two daily deliveries to each store are contemplated, rather than one, the scheduling of the entire processing operation is affected. The scheduling of production and labor for two deliveries a day is shown in figures 34 and 35 (pp. 75 and 76, appendix).

Before deliveries can be scheduled accurately, the number and volume of stores serviced, the length of delivery routes, the number of trucks, and the number of shipping containers for use on the day of maximum production must be determined.

Table 5 shows the number of shipping containers, 18 by 28 1/2 inches, required to service three stores with different volumes on the day of maximum sales. Meat sales were broken down into eight major categories in an attempt to segregate the products according to weight, size, and height as much as possible.

The following example is used to show how the total delivery time can be estimated. This central plant is to service 16 stores doing a total weekly volume of $100,000 with an average volume per store of $6,250. The round-trip distance from the central plant to the stores is 68 miles. This means that there would be 17 stops, because the last stop at

Table 5.--Shipping container requirements on peak volume days for stores of different volumes

	Sales, pkgs. weekly[1]	Sales, pkgs. peak day	Pkg./tub[2]	Tubs required on peak day
	$6,250 volume store			
	Number	Number	Number	Number
Steaks	476	143	50	3
Roasts	200	60	20	3
Ground meat	687	206	75	3
Misc. beef	346	104	50	3
Veal	66	20	55	1
Pork	546	164	30	6
Poultry	890	267	36	8
Lamb	6	2	5	1
			Total tubs	28
	$10,000 volume store			
Steaks	793	238	50	5
Roasts	335	100	20	5
Ground meat	1,145	343	75	5
Misc. beef	576	173	50	4
Veal	110	33	55	1
Pork	910	273	30	10
Poultry	1,482	445	36	12
Lamb	10	3	5	1
			Total tubs	43
	$16,667 volume store			
Steaks	1,319	395	50	8
Roasts	558	167	20	9
Ground meat	1,907	572	75	8
Misc. beef	960	288	50	6
Veal	184	55	55	1
Pork	1,519	451	30	15
Poultry	2,477	740	36	21
Lamb	16	5	5	1
			Total tubs	69

[1] Used product mix based on movement studies from 5 stores located in different areas c the country.

[2] Using a container size of 18" X 28" X 6".

the central plant would have to be included. The average distance between stops would be 4 miles. In this example, it was assumed that the most economical type of delivery truck was a self-contained refrigerated "bobtail" unit with inside dimensions 6 feet 10 inches wide by 18 feet long by 6 feet high.

Table 5 shows that each store with an average weekly volume of $6,250 would require 28 containers to fill the order on the day of maximum production. Therefore, to supply all 16 stores would require a total of 448 containers. The maximum number of shipping containers that can be loaded into the truck used in this example is 225, stacked 5 high; therefore, since 448 containers must be delivered, at least 2 trucks would be required when each truck made 1 daily delivery trip. The actual number of delivery trucks required is specified in the latter part of this section, which deals with overall scheduling of all phases of a central meat-processing operation.

An estimate of the total time required for delivery to a given number of stores may be obtained by calculating the actual driving time to the stores, time required to service the stores, time required to unload and check the orders, and normal stop times which occur during the delivery operations. To find the actual amount of driving time required, in the above example, use table 6 in the following manner:

1. Read vertically down the "Total miles" column until the line is reached which contains the total distance of 68 miles.

2. Follow this line horizontally across the table until a column is reached which contains the average distance of 4.0 miles per stop.

3. Read the figure appearing at the junction point, 234 minutes.

After the driving time has been arrived at, the next step is to find the length of time required to unload and check the order at the 16 stores being serviced. The times in tables 6, 7, and 8 were established for wholesale groceries, but have been checked for retail meat deliveries and found to be consistent.

Using table 7, the total unloading and checking time can be read from the table as follows:

1. Read vertically down the "Total pieces" column until a line is reached which contains 225 containers.

2. Read horizontally across the table until a column is reached which contains the average number of pieces per order (28).

3. Read the number of minutes used, appearing at the junction point (101).

The last operation in computing total time required on a delivery run is to find the normal stop times during the run. As used here, stop times are considered to be the small amounts of time that are not included in either unloading and checking time or travel time. This time includes such activities as preparing to unload the truck, receiving instructions from the retailer, and filling out information on the delivery manifest. Also included is unavoidable delay time at each delivery stop, such as waiting for dock space and waiting for the retailer to open the receiving door and sign the invoice. (6) These times were found to be consistent for all types of store deliveries.

Normal stop times on urban delivery trips can be found in table 8 as follows:

1. Read vertically down the "Total delivery stops" column until the number of stops is reached; in this case, it is 16.

2. Read horizontally along line 16 until the column is reached which includes the average containers per order, which is 28.

Table 6.--Normal driving times on urban delivery trips by wholesale grocers[1]

Total miles	Average distance per stop				
	Over 4 miles	3.1 to 4.0 miles	2.1 to 3.0 miles	1.6 to 2.0 miles	Under 1.5 miles
	Min.	Min.	Min.	Min.	Min.
4 to 6.....	17	18	20	24	35
6.1 to 8.....	24	24	28	34	49
8.1 to 10.....	31	32	36	43	63
10.1 to 12.....	37	38	44	53	77
12.1 to 14.....	44	46	52	62	91
14.1 to 16.....	51	52	60	72	105
16.1 to 18.....	58	60	68	82	119
18.1 to 20.....	65	66	76	91	133
20.1 to 22.....	71	74	84	101	149
22.1 to 24.....	78	80	92	110	161
24.1 to 26.....	85	88	100	120	175
26.1 to 28.....	92	92	108	130	189
28.1 to 30.....	99	100	116	139	203
30.1 to 32.....	105	106	124	149	217
32.1 to 34.....	112	114	132	158	231
34.1 to 36.....	119	120	140	169	245
36.1 to 38.....	126	128	148	178	259
38.1 to 40.....	133	134	156	187	273
40.1 to 42.....	139	142	164	197	
42.1 to 44.....	146	150	172	206	
44.1 to 46.....	153	156	180	216	
46.1 to 48.....	160	164	188	226	
48.1 to 50.....	167	172	196	235	
50.1 to 52.....	173	180	204		
52.1 to 54.....	180	186	212		
54.1 to 56.....	187	194	220		
56.1 to 58.....	194	200	228		
58.1 to 60.....	201	208	236		
60.1 to 62.....	207	214	244		
62.1 to 64.....	214	220	252		
64.1 to 66.....	221	228	260		
66.1 to 68.....	228	234			
68.1 to 70.....	235	242			

[1] See p. 17 of reference (8).

Table 7.--Normal unloading and checking times on urban delivery trips by wholesale grocers[1]

Total pieces (containers)	Average pieces per order											
	451 to 650 pcs.	351 to 450 pcs.	251 to 350 pcs.	151 to 250 pcs.	101 to 150 pcs.	71 to 100 pcs.	50 to 70 pcs.	31 to 50 pcs.	26 to 30 pcs.	21 to 25 pcs.	16 to 20 pcs.	15 pieces or under
	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.
200 to 225....				43	52	62	71	87	101	112	138	160
226 to 250....				48	58	69	80	98	113	125	155	178
251 to 275....			43	53	64	76	88	108	125	138	171	197
276 to 300....			47	58	71	84	96	118	137	151	187	216
301 to 325....			48	63	77	91	105	128	149	164	203	235
326 to 350....			52	68	83	98	113	138	160	177	220	254
351 to 375....		54	60	73	89	105	122	149	172	190	236	272
376 to 400....		58	64	78	95	112	130	159	184	203	252	291
401 to 425....		62	68	83	101	120	138	169	196	216	268	
426 to 450....		66	72	88	107	127	147	180	208	230	285	
451 to 475....	57	69	76	93	113	134	155	190	220	243	301	
476 to 500....	61	73	81	98	120	141	163	200	232	256	317	
501 to 525....	64	77	85	103	126	149	172	210	244	269	333	
526 to 550....	67	81	89	108	132	156	180	220	256	282		
551 to 575....	70	84	93	113	138	163	189	231	267	296		
576 to 600....	74	88	97	118	144	171	197	241	279	307		

[1] See p. 18 of reference (8).

For this set of circumstances, a total stop time of 96 minutes is indicated.

The total delivery time can be arrived at by adding together the three variables:

	Minutes
Normal travel time	234
Normal unloading and checking time	101
Normal stop time	96
Normal total delivery time	431

It takes approximately 7.2 hours to make a delivery run to 8 stores with 1 truck, or a total of slightly over 14 hours for servicing all 16 stores. Therefore, it is impractical to consider using one delivery truck.

Overall Scheduling of Operations

Management must have a method for determining when each of the major functions should be scheduled in relation to the others. In the chart in figure 33, the functions of processing orders for 16 stores, selecting and filling the orders, loading the delivery truck or trucks, and delivering the orders to the stores, are plotted with respect to total time in hours. The scheduling timetable at the bottom of the chart can be used to find the time the central plant should begin production.

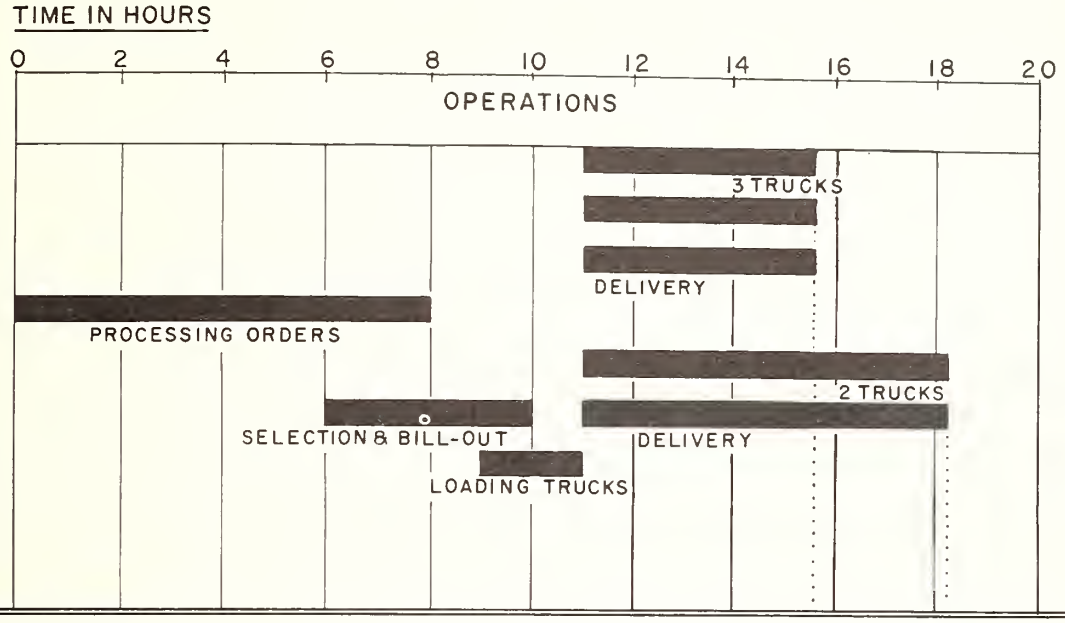
Table 8.--Normal stop times on urban delivery trips by wholesale grocers[1]

Total delivery stops	Average pieces per order								
	151 to 250 pieces	101 to 150 pieces	71 to 100 pieces	51 to 70 pieces	31 to 50 pieces	26 to 30 pieces	21 to 25 pieces	16 to 20 pieces	Under 16 pieces
	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.
1.....	17	16	12	9	7	6	5	4	3
2.....	34	32	24	18	14	12	10	8	6
3.....	51	48	36	27	21	18	15	12	9
4.....	68	54	48	36	28	24	20	16	12
5.....	85	70	60	45	35	30	25	20	15
6.....	102	86	72	54	42	36	30	24	18
7.....	119	112	84	63	49	42	35	28	21
8.....	136	128	96	72	56	48	40	32	24
9.....		144	108	81	63	54	45	36	27
10.....		160	120	90	70	60	50	40	30
11.....		176	132	99	77	66	55	44	33
12.....		192	144	108	84	72	60	48	36
13.....		208	156	117	91	78	65	52	39
14.....		224	168	126	98	84	70	56	42
15.....		240	180	135	105	90	75	60	45
16.....			192	144	112	96	80	64	48
17.....			204	153	119	102	85	68	51
18.....			216	162	126	108	90	72	54
19.....				171	133	114	95	76	57
20.....				180	140	120	100	80	60
21.....				189	147	126	105	84	63
22.....				198	154	132	110	83	66
23.....				207	161	138	115	92	69
24.....				216	168	144	120	96	70
25.....				225	175	150	125	100	73
26.....					182	156	130	104	76

[1] See p. 20 in reference (8).

Suppose management decides that the last store serviced should receive its order no later than 2 p.m. First, assume that all processing for the 16 stores will be done with 1 setup and the delivery made with 2 trucks. Using the upper portion of the chart, locate the bars on the chart representing delivery time with two trucks. A dotted line runs vertically from the end of the bars through the scheduling table. Follow the dotted line until it reaches a line containing 2 p.m. To find when the central plant must start processing, follow the 2 p.m. line horizontally until it intersects the beginning of the bar titled "Processing orders." The time of 8 p.m. is read at this intersection point. Therefore, for the last store on the delivery run to receive its order by 2 p.m., the central plant will have to commence processing the orders by 8 p.m., which is nearly 18 hours before the order is to arrive at the last store. If opening the central plant at 8 p.m. is

AN OVERALL TIME SCHEDULING SYSTEM TO INTEGRATE PRODUCTION AND DELIVERY OPERATIONS BASED ON A PREDETERMINED STORE ARRIVAL TIME 1/



SCHEDULING TABLE

8AM	10	12PM	2	4	6	8	10	12AM	2	4AM
10AM	12PM	2	4	6	8	10	12AM	2	4	6AM
12PM	2	4	6	8	10	12AM	2	4	6	8AM
2PM	4	6	8	10	12AM	2	4	6	8	10AM
4PM	6	8	10	12AM	2	4	6	8	10	12PM
6PM	8	10	12AM	2	4	6	8	10	12PM	2PM
8PM	10	12AM	2	4	6	8	10	12PM	2	4PM
10PM	12AM	2	4	6	8	10	12PM	2	4	6PM
12AM	2	4	6	8	10	12PM	2	4	6	8PM
2AM	4	6	8	10	12PM	2	4	6	8	10PM
4AM	6	8	10	12PM	2	4	6	8	10	12AM
6AM	8	10	12PM	2	4	6	8	10	12AM	2

1/ CENTRAL PLANT OPERATION SERVICING 16 STORES WITH A TOTAL WEEKLY VOLUME OF $100,000 AVERAGE WEEKLY VOLUME OF EACH STORE IS $6,250

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Figure 33.

not satisfactory to management, then it may be necessary to change operating methods. For instance, the firm may decide to use three delivery trucks. The chart shows that the central plant can now be opened at 10 p.m. and still have the order delivered to the last store by 2 p.m.

CONCLUSIONS AND RECOMMENDATIONS

Processing of fresh meat by conventional methods at the retail store has reached a level of efficiency which makes any further substantial reduction of processing costs difficult. But central packaging of retail cuts for distribution to the retail stores appears to be a method that can measurably decrease costs. Research has demonstrated that a shelf life of 2 to 5 days for packaged retail cuts is possible when proper refrigeration and sanitation practices are followed. With this length of shelf life, central packaging appears practical if it is done in accordance with an efficient production planning and control system.

In a central operation, it is necessary that an accurate and reliable method be used for determining the amount of daily sales, by retail cuts, for each store. A central operation cannot be successful unless daily store sales are accurately known. Also important is the establishment of an effective scheduling system for both labor and equipment. Management must decide when the last store that is to be serviced should receive its order. When this is decided, a scheduling system can be developed which takes into account the time required for the delivery operation, the loading of trucks, the selection and bill-out of the store orders, and, finally, the time it takes to process the orders for all the stores to be serviced. Proper scheduling enables the plant manager to determine when each operation must be performed to insure that the product is in the store display case when it is needed.

A central plant with a $250,000 weekly volume, servicing 40 stores with an average store volume in the vicinity of $6,250, could achieve an estimated yearly saving of over $600,000. Better discounts from packers and packaging suppliers would further increase the yearly savings.

Successful operation of a central plant is an intricate task and should not be attempted unless competent personnel are available.

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APPENDIX

Methodology

Researchers visited and studied the operations of several small central meat-processing plants in the United States. Observations were made of the methods and equipment used. Motion and time studies and flow process charts were made of each operation. Studies were made of product movement, inventories, sales space allocation, rewraps, ordering and scheduling techniques, and processing procedures. Operating expenses and other business records were analyzed.

Reports were made to management recommending changes in the operations based on the studies completed and on previous research in retail meat operations. These recommended changes in plant layout, equipment, work methods, scheduling, ordering, delivery, and store operations were made, and the results analyzed.

The methods, procedures, equipment, and layouts developed for these small plants were projected through budgeting techniques to larger scale operations. Equipment and construction cost estimates were obtained from the retail firms and from suppliers on a single-unit cost basis. Labor costs used were median for the firms studied.

The larger plants are described and pictured in this report. At least one of these plants and several stores have been completed, and construction and equipment cost estimates checked. Other recommendations regarding operation of these plants are being and will be continually developed and checked for accuracy as additional facilities are built.

Two new plants have been constructed according to floor plan layouts developed by the researchers, and one older plant has been remodeled. All architectural design work was done by local firms. Visits were made to at least six other firms, and much additional information was analyzed from other types of large meat-processing plants in this country and abroad. The recommendations and findings of the report also have been reviewed and checked for accuracy by a group of leading industry personnel, such as meat packers, retail chain store operators, suppliers, and university researchers.

Results obtained thus far are published to aid the industry in making evaluations of central fresh meat processing operations and to serve as guidelines for firms who plan to build central plants and distribute meat by this method.

Construction, equipment and labor estimates were calculated in the following manner:

I. Construction Costs for Central Meat Plants

A. $37,500 weekly volume central plant

1. Cost of building (shell):	
9,500 sq. ft. x $8.00 per sq. ft.	$76,000
2. Cost of cooler (meat and selection cooler):	
First 2,800 cu. ft. x $1.10 per cu. ft.	3,080
Remaining 20,340 cu. ft. x $.74 per cu. ft.	15,052
Total cost for 23,140 cu. ft. of cooler area	18,132
3. Cost of refrigerating the processing and bill-out area:	
First 2,800 cu. ft. x $1.10 per cu. ft.	3,080
Remaining 17,840 cu. ft. x $.74 per cu. ft.	13,202
Total cost for 20,640 cu. ft. of processing and bill-out areas	16,282
4. Cost of freezer:	
First 2,234 cu. ft. x $1.78 per cu. ft.	3,977
Remaining 3,095 cu. ft. x $1.09 per cu. ft.	3,374
Total cost for 5,329 cu. ft. of freezer area	7,351
Total construction cost	117,765

B. $75,000 weekly volume central plant

1. Cost of building (shell):	
12,774 sq. ft. x $8.00 per sq. ft.	102,192
2. Cost of cooler (meat and selection cooler):	
First 2,800 cu. ft. x $1.10 per cu. ft.	3,080
Remaining 28,389 cu. ft. x $.74 per cu. ft.	21,008
Total cost for 31,189 cu. ft. of cooler area	24,088
3. Cost of refrigerating the processing and bill-out area:	
First 2,800 cu. ft. x $1.10 per cu. ft.	3,080
Remaining 32,360 cu. ft. x $.74 per cu. ft.	23,946
Total cost for 35,160 cu. ft. of processing and bill-out areas	27,026
4. Cost of freezer:	
First 2,234 cu. ft. x $1.78 per cu. ft.	3,977
Remaining 5,360 cu. ft. x $1.09 per cu. ft.	5,842
Total cost for 7,594 cu. ft. of freezer area	9,819
Total construction cost	163,125

C. $250,000 weekly volume central plant

1. Cost of building (shell):	
17,650 sq. ft. x $8.00 per sq. ft.	$141,200
2. Cost of cooler (meat and selection cooler):	
First 2,800 cu. ft. x $1.10 per cu. ft.	3,080
Remaining 33,880 cu. ft. x $.74 per cu. ft.	25,071
Total cost for 36,680 cu. ft. of cooler area.	28,151
3. Cost of refrigerating the processing and bill-out areas:	
First 2,800 cu. ft. x $1.10 per cu. ft.	3,080
Remaining 61,360 cu. ft. x $.74 per cu. ft.	45,406
Total cost for 64,160 cu. ft. of processing and bill-out areas.	48,486
4. Cost of freezer:	
First 2,234 cu. ft. x $1.78 per cu. ft.	3,977
Remaining 17,840 cu. ft. x $1.09 per cu. ft.	19,446
Total cost 20,074 cu. ft. of freezer area	23,423
Total construction cost.	241,260

II. Construction Costs for Retail Store Meat Backrooms When Served by Central Plant

A. $3,125 weekly volume retail store

1. Cost of backroom (shell):	
332 sq. ft. x $8.00 per sq. ft.	2,656
2. Cost of cooler:	
960 cu. ft. x $1.10 per cu. ft.	1,056
3. Cost of freezer:	
640 cu. ft. x $1.63 per cu. ft.	1,043
Construction costs of one backroom	4,755
4. Construction costs of backrooms for 12 retail stores with total weekly volume of $37,500:	
$4,755 x 12 stores	57,060
5. Construction cost of backrooms for 24 retail stores with total weekly volume of $75,000:	
$4,755 x 24 stores	114,120

B. One $6,250 weekly volume retail store

1. Cost of backroom (shell):	
332 sq. ft. x $8.00 per sq. ft.	2,656
2. Cost of cooler:	
960 cu. ft. x $1.10 per cu. ft.	1,056
3. Cost of freezer:	
640 cu. ft. x $1.63 per cu. ft.	1,043
Construction costs for one backroom	4,755

4. Construction costs of backrooms for 6 retail stores with total weekly volume of $37,500:
$4,755 x 6 stores $28,530

5. Construction costs of backrooms for 12 retail stores with total weekly volume of $75,000:
$4,755 x 12 stores 57,060

6. Construction costs of backrooms for 40 retail stores with total weekly volume of $250,000:
$4,755 x 40 stores 190,200

C. One $10,000 weekly volume retail store

1. Cost of backroom (shell):
372 sq. ft. x $8.00 per sq. ft. 2,976

2. Cost of cooler:
1,280 cu. ft. x $1.10 per cu. ft. 1,408

3. Cost of freezer:
640 cu. ft. x $1.63 per cu. ft. 1,043

Construction costs for one backroom 5,427

4. Construction costs of backrooms for 25 retail stores with total weekly volume of $250,000:
$5,427 x 25 stores 135,675

D. One $16,667 weekly volume retail store

1. Cost of backroom (shell):
492 sq. ft. x $8.00 per sq. ft. 3,936

2. Cost of cooler:
2,240 cu. ft. x $1.10 per cu. ft. 2,464

3. Cost of freezer:
640 cu. ft. x $1.63 per cu. ft. 1,043

Construction costs for one backroom 7,443

4. Construction costs of backrooms for 15 retail stores with total weekly volume of $250,000:
$7,443 x 15 111,645

III. Construction Costs for Retail Store Meat Departments When Served from Conventional Backrooms

A. One $3,125 weekly volume retail store

1. Cost of backroom (shell):
805 sq. ft. x $8.00 per sq. ft. $6,440

2. Cost of cooler:
1,800 cu. ft. x $1.10 per cu. ft. 1,980

3. Cost of freezer:
640 cu. ft. x $1.63 per cu. ft. 1,043

Construction costs for one backroom 9,463

4. Construction costs for one backroom for 12 retail stores with total weekly volume of $37,500:
$9,463 x 12 stores 113,556

5. Construction costs of backrooms for 24 retail stores with total weekly volume of $75,000:
   $9,463 x 24 stores $227,112

B. One $6,250 weekly volume retail store

1. Cost of backroom (shell):
   1,080 sq. ft. x $8.00 per sq. ft. 8,640
2. Cost of cooler:
   2,400 cu. ft. x $1.10 per cu. ft. 2,640
3. Cost of freezer:
   640 cu. ft. x $1.63 per cu. ft. 1,043
   Construction costs for one backroom 12,323
4. Construction costs of backrooms for 6 retail stores with total weekly volume of $37,500:
   $12,323 x 6 stores 73,938
5. Construction costs of backrooms for 12 retail stores with total weekly volume of $75,000:
   $12,323 x 12 stores 147,876
6. Construction costs of backrooms for 40 retail stores with total weekly volume of $250,000:
   $12,323 x 40 stores 492,920

C. One $10,000 weekly volume retail store

1. Cost of backroom (shell):
   1,480 sq. ft. x $8.00 per sq. ft. 11,840
2. Cost of cooler:
   First 2,800 cu. ft. x $1.10 per cu. ft. 3,080
   Remaining 400 cu. ft. x $.74 per cu. ft. 296
   Total cost for 3,200 cu. ft. of cooler area 3,376
3. Cost of freezer:
   640 cu. ft. x $1.63 per cu. ft. 1,043
   Construction costs for one backroom 16,259
4. Construction costs of backrooms for 25 retail stores with weekly volume of $250,000:
   $16,259 x 25 stores 406,475

D. One $16,667 weekly volume retail store

1. Cost of backroom (shell):
   1,980 sq. ft. x $8.00 per sq. ft. 15,840
2. Cost of cooler:
   First 2,800 cu. ft. x $1.10 per cu. ft. 3,080
   Remaining 2,800 cu. ft. x $.74 per cu. ft. 2,072
   Total cost for 5,600 cu. ft. of cooler area 5,152
3. Cost of freezer:
   640 cu. ft. x $1.63 per cu. ft. 1,043
   Construction costs for one backroom 22,035
4. Construction costs of backrooms for 15 retail stores with total weekly volume of $250,000:
   $22,035 x 15 stores 330,525

Table 9.--Equipment requirements and costs for a $37,500 weekly volume central meat plant

Equipment	Pieces required	Unit cost	Total cost
	Number	Dollars	Dollars
Cutting tables	3	100.00	300
Cutting tools	3	40.00/station	120
Chopper	2	702.50	1,405
Meat block	3	65.00	195
Power saw	3	840.00	2,520
Liver table and loader	1	65.00	65
Cuber, slicer table, and equipment	1	910.00	910
Hand-wrap station	2	375.00	750
Automatic scale and label printer	1	4,700.00	4,700
Auto wrap machine	1	6,400.00	6,400
Transfer and labeling machine	1	2,500.00	2,500
Shrink tunnel	1	500.00	500
Prewrap shrink table	1	237.00	237
Misc. table	1	57.00	57
Ball transfer table	1	23.00	23
24" skate wheel conveyor	61 ft.	8.73/ft.	533
18" skate wheel conveyor	32 ft.	7.25/ft.	232
Office equipment--desks and 2 chairs	2	100.00	200
Freezer racks	8	248.00	1,984
Storage racks--main cooler	9	248.00	2,232
Portable tray rack	2	50.00	100
Utility lugs	35	12.00	420
Lug racks	5	42.00	210
Tubs--main cooler	150	6.00	900
Tubs--freezer	100	6.00	600
Holding racks (selection)	30	55.00	1,650
Tubs for holding racks (selection)	700	6.00	4,200
Adding machine	2	300.00	600
Meat rail	439 ft.	5.10/ft.	2,239
Lounge equipment	1	100.00	100
Time clock	1	150.00	150
File cabinet	3	50.00	150
Meat rail scale	1	2,000.00	2,000
Meat pans	200	3.25	650
Dolly and galvanized drum	3	35.00	105
Handtrucks	3	18.75	56
Totals			39,993

Table 10.--Equipment requirements and costs for a $75,000 weekly volume central meat plant

Equipment	Pieces required	Unit cost	Total cost
	Number	Dollars	Dollars
Chopper	2	702.50	1,405
Automatic scale and label printer	1	4,700.00	4,700
Transfer and labeling machine	1	2,500.00	2,500
Wrap tables	3	375.00	1,125
24" gravity conveyor	19 ft.	8.73/ft.	166
24" power conveyor	25 ft.	11.00/ft.	275
24" gravity conveyor	5 ft.	8.73/ft.	44
18" gravity conveyor	20 ft.	7.25/ft.	145
18" belt conveyor	14 ft.	24.20/ft.	339
18" gravity conveyor	23 ft.	7.25/ft.	167
24" gravity conveyor	10 ft.	8.73/ft.	87
Ball transfer table	6 ft.	7.00/ft.	42
24" gravity conveyor	60 ft.	8.73/ft.	524
12" roller conveyor	4 ft.	9.70/ft.	39
Meat rail scale	1	2,000.00	2,000
Platform scale	1	105.00	105
Meat saw	5	840.00	4,200
Auto wrap machine	1	6,400.00	6,400
Meat pans	400	3.25	1,300
Meat block	5	65.00	325
Dolly and galvanized drum	6	35.00	210
Slicer and cuber	1	810.00	810
Cutting tables	5	100.00	500
Cutting tools	5	40.00	200
Portable tray rack	2	50.00	100
Utility lug	45	12.00	540
Lug racks	7	42.00	294
Meat rail	527 ft.	5.10/ft.	2,688
Storage racks (cooler)	10	248.00	2,480
Liver table	1	57.00	57
Shrink tunnel	1	500.00	500
Shrink prewrap table	1	237.00	237
Storage racks, freezer	8	248.00	1,984
Desk and chair	3	100.00	300
Lounge equipment		300.00	300
Tubs (cooler)	254	6.00	1,524
Slicer table	1	100.00	100
Holding racks (selection)	42	55.00	2,310
Time clock	1	150.00	150
Adding machine	2	300.00	600
File cabinet	5	50.00	250
Tubs for holding racks	1,100	6.00	6,600
Total equipment			48,622

Table.11.--Equipment requirements and cost for a $250,000 weekly volume central meat plant

Equipment	Pieces required	Unit cost	Total cost
	Number	Dollars	Dollars
24" gravity flow conveyor	1,183 ft.	8.73/ft.	10,328
24" power conveyor	97 ft.	11.00/ft.	1,067
24" belt conveyor	29 ft.	25.30/ft.	734
18" gravity flow conveyor	63 ft.	7.25/ft.	457
18" belt conveyor	26 ft.	24.20/ft.	629
15" belt conveyor	35 ft.	23.10/ft.	809
12" belt conveyor	21 ft.	21.00/ft.	441
12" roller conveyor	18 ft.	9.70/ft.	175
Ball transfer tables	15 ft.	7.00/ft.	105
Meat rail scale	2	2,000	4,000
Hamburger mill	2	800	1,600
Platform scale	1	250	250
Scale (boning operation)	1	80	80
Steam cleaner	4	555	2,220
Storage racks (freezer)	12	248	2,976
Storage racks (cooler)	11	248	2,728
Tubs (cooler)	164	15	2,460
Boning table	2	334	668
Misc. table (blocking)	4	82	328
Misc. table (boning)	1	58	58
Meat pans	1,438	3	4,314
Cuber-slicer with table	2	900	1,800
Liver table	1	58	58
Shrink wrap table	3	237	711
Shrink tunnel	1	500	500
USDA handwrap table	8	375	3,000
Misc. table	1	60	60
Auto wrap machine	3	6,400	19,200
Automatic scale and label printer	3	4,700	14,100
Transfer and labeling machine	3	2,500	7,500
Meat cutting tables	14	100	1,400
Meat blocks	14	65	910
Power saws	14	840	11,760
Meat rail	884 ft.	5/ft.	4,420
Cutting tools	14	40/station	560
Holding racks (selection)	40	54	2,160
Tubs for racks	757	15	11,355
Lounge equipment		400	400
Time clock	1	200	200
Electric adding machine	2	300	600
Desk and chairs	5	100	500
File cabinet	10	50	500
Total			118,121

Table 12.--Comparative equipment costs for a store ($3,125 weekly volume) serviced by conventional methods and by a central meat plant

Equipment	Store serviced conventionally	Store serviced by central plant
	Dollars	Dollars
Meat chopper	295	295
Automatic scale and label printer	4,700	
Small scale		195
Miscellaneous table		72
USDA handwrap table	375	
Conveyor 24" skate wheel	175	
Meat saw	840	
Hand irons		23
Cutting tools	80	40
Meat pans	244	33
Meat block	65	40
Cutting tables	200	
Dolly and galvanized drum	70	35
Slicer, cuber, and table	900	900
Meat rail scale	2,000	
Boning table	227	
Portable tray rack	50	
Meat rail	200	
Utility lugs	72	12
Lug racks	42	
Galvanized shelf	248	248
Tray racks	120	30
Shipping containers		120
Handcart		18
TOTALS	10,903	2,061

Table 13.--Comparative equipment costs for a store ($6,250 weekly volume) serviced by conventional methods and by a central meat plant

Equipment	Store serviced conventionally	Store serviced by central plant
	Dollars	Dollars
Meat chopper	295	295
Automatic scale and label printer	4,700	
Small scale		195
Miscellaneous table		72
USDA handwrap table	750	
Conveyor	104	
Meat saw	840	
Hand irons		23
Meat pans	325	49
Small meat block		40
Meat block	65	
Dolly and galvanized drum	70	35
Slicer and cuber	810	810
Cutting tables	200	
Cutting tools (set)	80	40
Meat rail scale	2,000	
Boning table	227	
Dolly tray rack	50	
Meat rail	302	
Handtruck		18
Utility lugs (small)		16
Utility lugs (large)	120	
Lug racks	84	
Shipping containers		180
Galvanized shelf	248	248
Tray racks	150	60
TOTALS	11,420	2,081

Table 14.--Comparative equipment costs for a store ($10,000 weekly volume) serviced by conventional methods and by a central meat plant

Equipment	Store serviced conventionally	Store serviced by central plant
	Dollars	Dollars
Meat chopper	586	295
Dolly tray rack	50	
Dolly and galvanized drum	105	35
Automatic scale and label printer	4,700	
Small scale		185
Tray racks (12' section)		40
Tray racks (10' section)	275	
Miscellaneous table		72
USDA handwrap table	750	
Galvanized shelves	496	248
Conveyor	130	
Lugs	216	16
Handtrucks		18
Conveyor	104	
Boning table	273	
Meat power saws	840	
Hand irons		23
Wrapping machine	4,500	
Lug racks (small)		30
Lug racks (large)	126	
Meat pans	650	70
Meat rail	530	
Meat block	130	40
Cutting table	300	
Meat rail scale	2,000	
Slicer and cuber	810	810
Cutting tools	120	40
Shipping containers		270
TOTALS	17,691	2,192

Table 15.--Comparative equipment costs for a store ($16,667 weekly volume) serviced by conventional methods and by a central meat plant

Equipment	Store serviced conventionally	Store serviced by central plant
	Dollars	Dollars
Meat chopper	705	295
Automatic scale and label printer	4,700	195
USDA handwrap table	1,125	72
Conveyor	261	
Meat saw	1,680	
Wrapping machine	4,500	23
Meat pans	975	130
Meat block	195	40
Dolly and galvanized drum	140	35
Slicer and cuber	810	810
Cutting tables	400	
Cutting tools	160	40
Meat rail scale	2,000	
Boning table	334	
Portable tray rack	50	
Meat rail	663	
Utility lugs	300	16
Lug racks	168	30
Galvanized shelf	744	248
Tray racks	350	75
Shipping containers		420
TOTALS	20,260	2,429

Table 16.--Labor force at a $37,500 weekly volume central meat plant (40-hour week)

Personnel	Job description	Weekly wage rate	Total yearly wages
Number		Dollars	Dollars
1	Plant manager	175.00	9,100
1	Clerk-typist (part-time)	62.58	3,254
1	Bill-out man	81.72	4,249
1	Delivery man	87.44	4,547
1	Head meat cutter	111.25	5,785
1	Meat cutter (2nd man)	111.25	5,785
2	Meat cutter	111.25	11,570
1	Mill man	111.25	5,785
1	Blocker	111.25	5,785
1	Apprentice	87.44	4,547
1	Cleanup man	87.44	4,547
1	Wrapper (machine)	81.72	4,249
1	Wrapper (H. W.)	81.72	4,249
1	Scale girl	81.72	4,249
15			77,701

Table 17.--Total labor expenditure for stores served by a $37,500 weekly volume central meat plant

Volume of stores	Stores	Men/store	Total men all stores	Weekly wage rate per man	Yearly wage/man	Total yearly wages for all stores
Dollars	Number	Number	Number	Dollars	Dollars	Dollars
3,125	12	1 1/3	16	130.25	6,773	108,368
6,250	6	1 1/3	8	130.25	6,773	54,184

Table 18.--Labor force at a $75,000 weekly volume central meat plant (40-hour week)

Personnel	Job description	Weekly wage rate	Total yearly wages
Number		Dollars	Dollars
1	Plant manager.....	175.00	9,100
1	Order selector.....	87.44	4,547
1	Bill-out man.....	81.72	4,249
4	Cutters.....	111.25	23,140
1	Delivery man.....	87.44	4,547
2	Trimmers and boarders.....	111.25	11,570
2	Boners.....	87.44	9,094
1	Blocker.....	111.25	5,785
3	Hand wrappers.....	81.72	12,748
1	Machine wrapper.....	81.72	4,249
1	Hobart 2,000 operator.....	81.72	4,249
2	Mill operators.....	111.25	11,570
1	Clerk-typist.....	75.00	3,900
21			$108,748

Table 19.--Total labor expenditure for stores served by a $75,000 weekly volume central meat plant

Volume of stores	Stores	Men/store	Total men all stores	Weekly wage rate per man	Yearly wage/man	Total yearly wages for all stores
Dollars	Number	Number	Number	Dollars	Dollars	Dollars
3,125	24	1 1/3	32	130.25	6,773	216,736
6,250	12	1 1/3	16	130.25	6,773	108,368
10,000	8	2	16	130.25	6,773	108,368

Table 20.--Labor force at a $250,000 weekly volume central meat plant (40-hour week)

Personnel	Job description	Weekly wage rate	Total yearly wages
Number		Dollars	Dollars
1	Plant manager.....	225.00	11,700
1	Assistant manager.....	175.00	9,100
10	Cutters.....	111.25	57,850
10	Trimmers and boarders.....	111.25	57,850
4	Mill operator.....	111.25	23,140
8	Hand operator.....	81.72	33,995
3	Auto. wrapper.....	81.72	12,748
3	Automatic scale operator.....	81.72	12,748
2	Blockers.....	111.25	11,570
4	Boners.....	111.25	23,140
1	Clerk-typist.....	76.23	3,964
2	Clerk.....	75.00	7,800
2	Order selector.....	87.44	9,094
6	Bill-out.....	81.72	25,497
57			300,196

Table 21.--Total labor expenditure for stores served by a $250,000 weekly volume central meat plant

Volume	Stores	Average of men/store	Total men all stores	Weekly wage rate per man	Yearly wage/man	Total yearly wages for all stores
Dollars	Number	Number	Number	Dollars	Dollars	Dollars
6,250	40	1 1/3	53 1/3	130.25	6,773	361,200
10,000	25	2	50	130.25	6,773	338,650
16,667	15	2	30	130.25	6,773	203,190

Table 22.--Labor requirements for conventional-type meat backrooms of different volumes

Job description	Weekly wage rate	Labor force used in $3,125 volume store	Total yearly wages	Labor force used in $6,250 volume store	Total yearly wages	Labor force used in $10,000 volume store	Total yearly wages	Labor force used in $16,667 volume store	Total yearly wages
	Dollars		Dollars		Dollars		Dollars		Dollars
Meat manager.....	130.25	1	6,773	1	6,773	1	6,773	1	6,773
Assistant meat manager.....	111.25							1	5,785
Cutters.....	111.25	1	5,785	2	11,570	3	17,356	5	28,926
Mill operator....	111.25					1	5,785	1	5,785
Wrappers.....	81.72	1	4,249	2	8,498	3	12,748	4	16,997
Scale operator...	81.72	1	4,249	1	4,249	1	4,249	1	4,249
Total.....		4	21,057	6	31,090	9	46,911	13	68,515

COMBINED CONSTRUCTION, EQUIPMENT, AND LABOR COST OF CENTRAL PLANT OPERATIONS AND CONVENTIONAL BACKROOM OPERATIONS

I. Annual depreciated construction costs

A. $37,500 weekly volume operation

1. Central plant: $117,765 x .16275 (crf)	$19,166	
2. 6 stores served by central plant: $28,530 x .16275 (crf)	4,643	
3. 12 stores served by central plant: $57,060 x .16275 (crf)	9,287	
4. Central plant plus 6 stores		$23,809
5. Central plant plus 12 stores		28,453
6. 6 stores served by own backrooms: $73,938 x .16275 (crf)		12,033
7. 12 stores served by own backrooms: $113,556 x .16275 (crf)		18,481

B. A $75,000 weekly volume operation

1. Central plant: $163,125 x .16275 (crf)	26,549	
2. 12 stores served by central plant: $57,060 x .16275 (crf)	9,287	
3. 24 stores served by central plant: $114,120 x .16275 (crf)	18,573	
4. Central plant plus 12 stores		35,836
5. Central plant plus 24 stores		45,122
6. 12 stores served by own backrooms: $147,876 x .16275 (crf)		24,067
7. 24 stores served by own backrooms: $227,112 x .16275 (crf)		36,962

C. A $250,00 weekly volume operation

1. Central plant: $241,260 x .16275 (crf)	39,265	
2. 15 stores served by central plant: $111,645 x .16275 (crf)	18,170	
3. 25 stores served by central plant: $135,675 x .16275 (crf)	22,081	
4. 40 stores served by central plant: $190,200 x .16275 (crf)	30,955	
5. Central plant plus 15 stores		57,435

6. Central plant plus 25 stores		$61,346
7. Central plant plus 40 stores		70,220
8. 15 stores served by own backrooms: $330,525 x .16275 (crf)		53,793
9. 25 stores served by own backrooms: $406,475 x .16275 (crf)		66,154
10. 40 stores served by own backrooms: $492,920 x .16275 (crf)		80,223

II. Annual depreciated equipment costs

A. $37,500 weekly volume operation

1. Central plant: $39,993 x .26380 (crf)	$10,550	
2. 6 stores served by central plant: $12,486 x .26380 (crf)	3,294	
3. 12 stores served by central plant: $24,732 x .26380 (crf)	6,524	
4. Central plant plus 6 stores		13,844
5. Central plant plus 12 stores		17,074
6. 6 stores served by own backrooms: $68,520 x .26380 (crf)		18,076
7. 12 stores served by own backrooms: $130,836 x .26380 (crf)		34,515

B. A $75,000 weekly volume operation

1. Central plant: $48,622 x .26380 (crf)	12,826	
2. 12 stores served by central plant: $24,972 x .26380 (crf)	6,588	
3. 24 stores served by central plant: $49,464 x .26380 (crf)	13,048	
4. Central plant plus 12 stores		19,414
5. Central plant plus 24 stores		25,874
6. 12 stores served by own backrooms: $137,040 x .26380 (crf)		36,151
7. 24 stores served by own backrooms: $261,672 x .26380 (crf)		69,029

C. A $250,000 weekly volume operation

1. Central plant: $118,121 x .26380 (crf)	$31,160	
2. 15 stores served by central plant: $36,435 x .26380 (crf)	9,612	
3. 25 stores served by central plant: $54,800 x .26380 (crf)	14,456	
4. 40 stores served by central plant: $83,250 x .26380 (crf)	21,959	
5. Central plant plus 15 stores		$40,772
6. Central plant plus 25 stores		45,616
7. Central plant plus 40 stores		53,119
8. 15 stores served by own backrooms: $303,900 x .26380 (crf)		80,169
9. 25 stores served by own backrooms: $442,275 x .26380 (crf)		116,672
10. 40 stores served by own backrooms: $456,800 x .26380 (crf)		120,504

III. Annual labor cost

A. A $37,500 weekly volume operation

1. Central plant	77,701	
2. 6 stores served by central plant	54,184	
3. 12 stores served by central plant	108,368	
4. Central plant plus 6 stores		131,885
5. Central plant plus 12 stores		186,069
6. 6 stores served by own backrooms		186,540
7. 12 stores served by own backrooms		252,684

B. A $75,000 weekly volume operation

1. Central plant	108,748	
2. 12 stores served by central plant	108,368	
3. 24 stores served by central plant	216,736	
4. Central plant plus 12 stores		217,116
5. Central plant plus 24 stores		325,484
6. 12 stores served by own backrooms		373,080
7. 24 stores served by own backrooms		505,368

C. A $250,000 weekly volume operation

1. Central plant	$300,196	
2. 15 stores served by central plant	203,190	
3. 25 stores served by central plant	338,650	
4. 40 stores served by central plant	361,200	
5. Central plant plus 15 stores		$503,386
6. Central plant plus 25 stores		638,846
7. Central plant plus 40 stores		661,396
8. 15 stores served by own backrooms		1,027,725
9. 25 stores served by own backrooms		1,172,775
10. 40 stores served by own backrooms		1,243,600

Table 23.--Summary of overall costs and other operational information for central plants of different volumes supplying small-, medium-, and high-volume retail stores

Description of overall costs and other operational information	Store with own backroom				Store served by central plant				Individual central plant			$37,500 weekly volume			
												6 stores, average volume $6,250		12 stores, average volume $3,125	
	$3,125 wk. vol.	$6,250 wk. vol.	$10,000 wk. vol.	$16,667 wk. vol.	$3,125 wk. vol.	$6,250 wk. vol.	$10,000 wk. vol.	$16,667 wk. vol.	$37,500 wk. vol.	$75,000 wk. vol.	$250,000 wk. vol.	With own backrooms	Served by central plant	With own backrooms	Served by central plant
	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Capital costs: Construction costs	9,463	12,323	16,259	22,035	4,755	4,755	5,427	7,443	117,765	163,125	241,260	73,938	146,295	113,556	174,825
Equipment costs	10,903	11,420	17,691	20,260	2,061	2,081	2,192	2,429	39,993	48,622	118,121	68,520	52,479	130,836	64,725
Annual depreciated costs of construction and equipment									29,716	39,375	70,425	30,109	37,653	52,996	45,527
Annual labor costs	21,057	31,090	46,911	68,515	9,030	9,030	13,546	13,546	77,701	108,748	300,196	186,540	131,885	252,684	186,069
Total annual cost of operation									107,417	148,123	370,621	216,649	169,538	305,680	231,596
Total annual savings in central plant operation													47,111		74,084
Percent savings in annual costs with central plant operation													Percent 21.7		Percent 24.2
Supplemental information:															
Total number personnel	4	6	9	13	1 1/3	1 1/3	2	2	15	21	57	36	20	48	28
Man-hours per week	160	240	360	520	53	53	80	80	600	840	2,280	1,440	800	1,920	1,120
Sales per man-hour (dollars)									62.50	89.29	109.65	26.04	46.88	19.53	33.48
Labor as a percentage of gross sales									4.0	2.8	2.3	9.6	6.8	13.0	9.5

Description of overall costs and other operational information	$75,000 weekly volume				$250,000 weekly volume					
	12 stores, average volume $6,250		24 stores, average volume $3,125		15 stores, average volume $16,667		25 stores, average volume $10,000		40 stores, average volume $6,250	
	With own backrooms	Served by central plant	With own backrooms	Served by central plant	With own backrooms	Served by central plant	With own backrooms	Served by central plant	With own backrooms	Served by central plant
	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Capital costs: Construction costs	147,876	220,185	227,112	277,247	330,525	352,905	406,475	376,935	492,920	431,460
Equipment costs	137,040	73,594	261,672	98,086	303,900	154,556	442,275	172,921	456,800	201,361
Annual depreciated costs of construction and equipment	60,218	55,250	105,991	70,996	133,962	98,207	182,826	106,962	200,727	123,339
Annual labor costs	373,080	217,116	505,368	325,484	1,027,725	503,386	1,172,775	638,846	1,243,600	661,396
Total annual cost of operation	433,298	272,366	611,359	396,480	1,161,687	601,593	1,355,601	745,808	1,444,327	784,735
Total annual savings in central plant operation		160,932		214,879		560,094		609,793		659,592
Percent savings in annual costs with central plant operation		Percent 37.1		Percent 35.1		Percent 48.1		Percent 45.0		Percent 45.7
Supplemental information:										
Total number personnel	72	37	96	53	195	87	225	107	240	110
Man-hours per week	2,880	1,480	3,840	2,120	7,800	3,480	9,000	4,280	9,600	4,400
Sales per man-hour (dollars)	26.04	50.68	19.53	35.38	32.05	71.84	27.78	58.41	26.04	56.82
Labor as a percentage of gross sales	9.6	5.6	13.0	8.3	7.9	3.9	9.0	4.9	9.6	5.1

Note: Fringe benefits not included. Labor requirements and wage rates, construction requirements and costs, equipment requirements and costs, and combined construction, equipment, and labor costs are shown in other portions of the appendix.

Table 24.--Sales breakdown by major categories of central plant processing $100,000 in fresh meats

Category	Proportion of meat sold[1]	Sales
	Percent	Dollars
Beef steaks	23.5	23,500
Beef roasts	9.8	9,800
Ground meat	12.2	12,200
Misc. beef	1.9	1,900
Veal	1.5	1,500
Pork, fresh	7.6	7,600
Lamb	2.4	2,400
Poultry	22.4	22,400
Hams	18.7	18,700
Total	100.0	100,000

[1] Percentage of product sold is an average figure of sales by retail food stores observed in the eastern and midwestern sections of the country.

Table 25.--Derived cutting time for steaks

Item	Retail cuts	Time per pkg.[1]	Total time
	Number	Minutes	Minutes
Sirloins	90	.127	11.430
T-bones	192	.078	14.976
Top round	217	.186	40.362
Bottom round	230	.187	43.010
Rib steaks	179	.219	39.201
Total	908		148.979

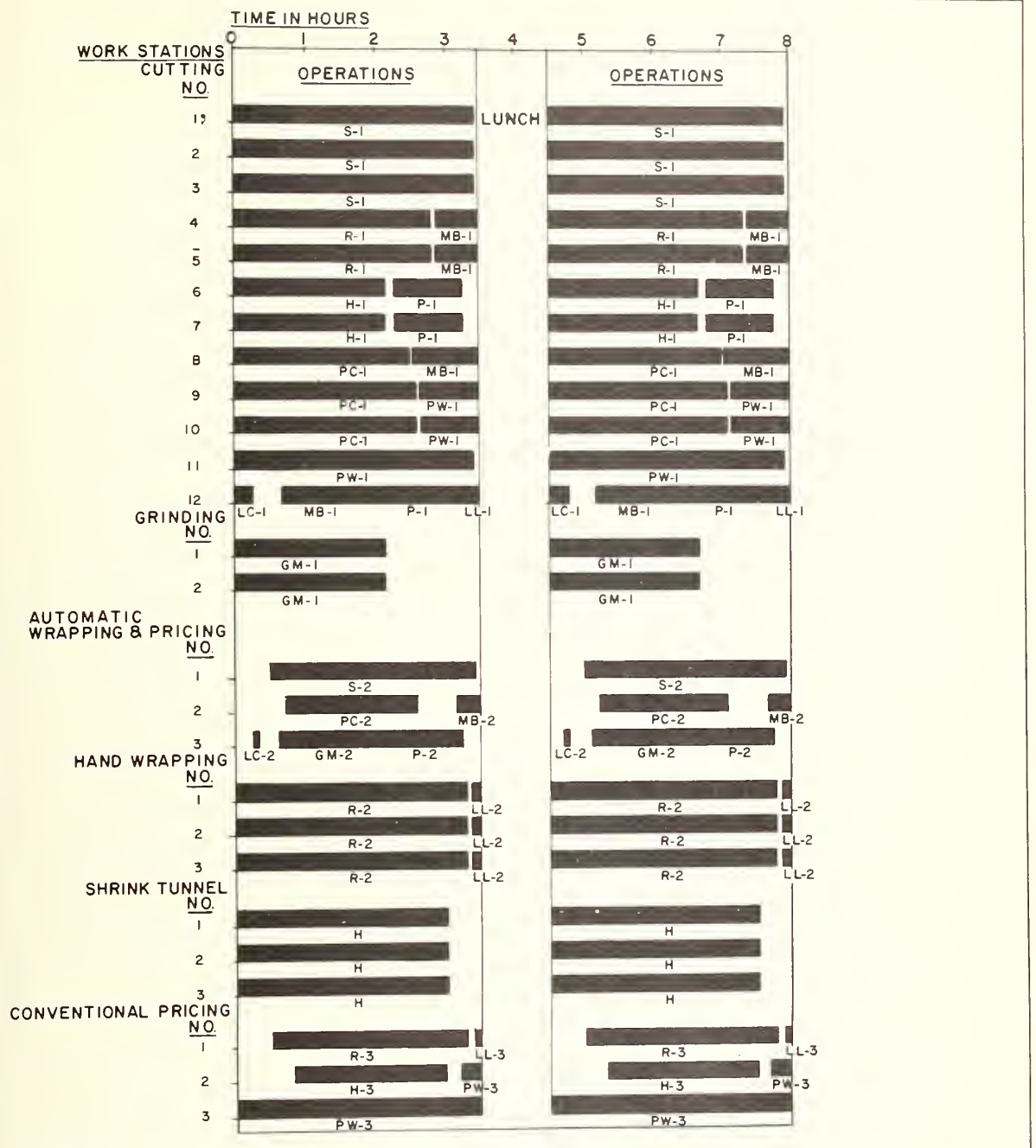
[1] These are estimated cutting times based on standard times from MRR No. 41. Because of production-line layout of central plant, certain irregular elements have been eliminated in calculating the cutting times appearing in this table. Calculations: Normal time $\frac{148.979}{908}$ = .164 min./pkg. Standard time .164 x 115 = .189 min./pkg.

Table 26.--Derived cutting time for roasts.

Item	Retail cuts	Time per pkg.[1]	Total time
	Number	Minutes	Minutes
Pork loin roast	21	.101	2.121
Rib end roasts	2	.246	.492
Jiffys	10	.223	2.230
Spareribs	10	.254	2.540
Backbone	10	.262	2.620
Total	53		10.003

[1] Calculations: Normal time $\frac{10.003}{53}$ = .189 min./pkg. Standard time per package .189 x 115 = .217 min./pkg.

PROCESSING TIME OF OPERATIONS PERFORMED ON EACH MAJOR MEAT CATEGORY SCHEDULED AT SPECIFIC WORK STATIONS IN A $100,000 WEEKLY VOLUME CENTRAL MEAT PLANT BASED ON TWO DAILY SET-UPS 1/



LEGEND

S--Steak GM--Ground Meat P--Pork LC--Lamb Chops PC--Poultry (cut-up)
R--Roast MB--Miscellaneous Beef LL-Leg of Lamb PW-Poultry (whole) H--Ham

OPERATIONS

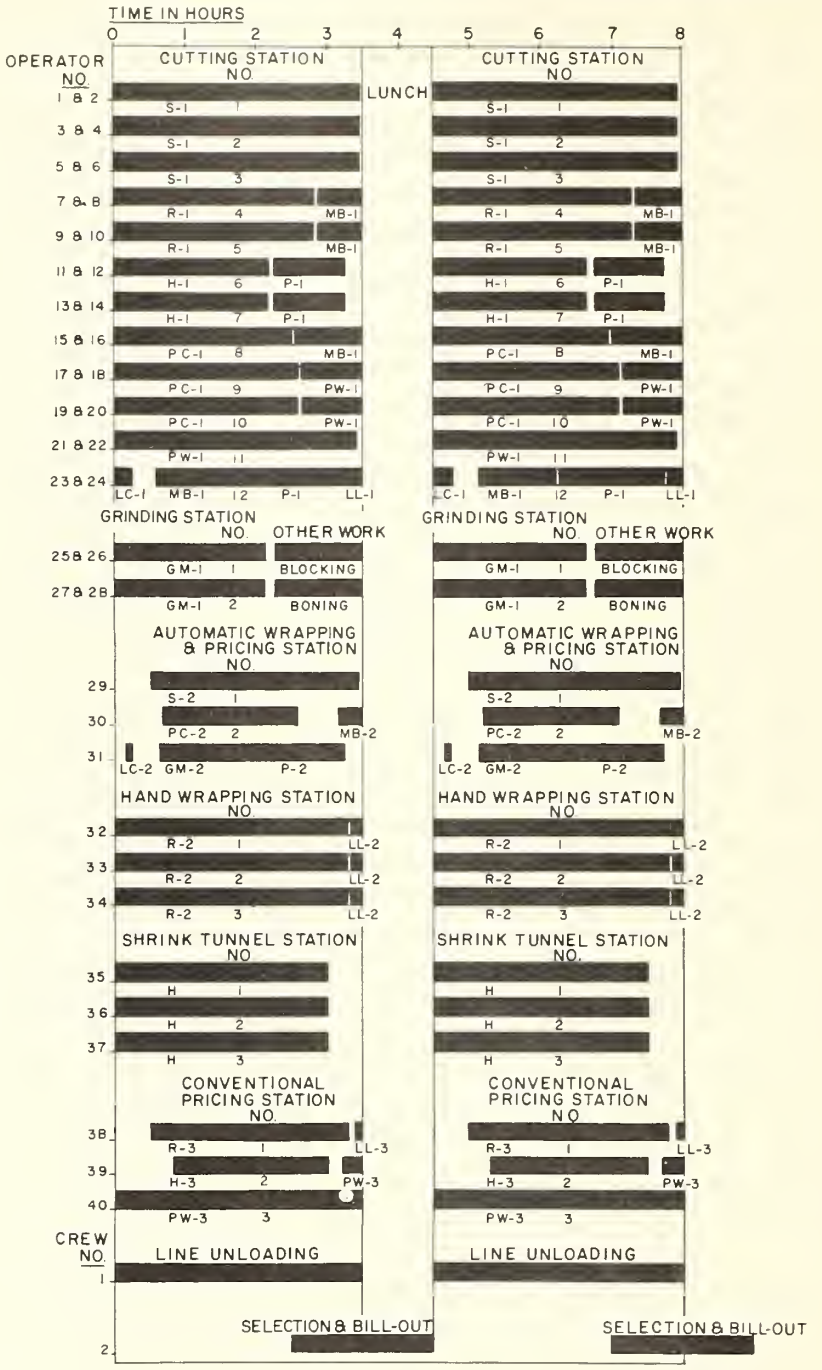
1--Cutting, Traying, Grinding or Bagging 2--Automatic Wrapping & Pricing or Hand Wrapping
3--Conventional Pricing

1/ DAY OF MAXIMUM PRODUCTION

U.S. DEPARTMENT OF AGRICULTURE NEG. AMS 340-63(4) AGRICULTURAL MARKETING SERVICE

Figure 34.

LABOR SCHEDULED AT SPECIFIC WORK STATIONS IN A $100,000 WEEKLY VOLUME CENTRAL MEAT PLANT BASED ON TWO DAILY SET-UPS 1/



LEGEND

S--Steak GM--Ground Meat P--Pork LC--Lamb Chops PC--Poultry (cut-up)
R--Roast MB--Miscelloneous Beef LL-Leg of Lamb PW-Poultry (whole) H--Ham

OPERATIONS

1--Cutting, Troying, Grinding or Bagging 2--Automatic Wrapping & Pricing or Hand Wrapping
3--Conventional Pricing

1/ DAY OF MAXIMUM PRODUCTION

US DEPARTMENT OF AGRICULTURE NEG. AMS 341-63(4) AGRICULTURAL MARKETING SERVICE

Figure 35.